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How Rubber is Manufactured to Suit Many Purposes
S. G. Roberts

Oil Shales and Their Potentialities
R. H. Tingley

Raising Wholly Submerged Ships by Compressed Air
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America's Queen of the Seas The S. S. Leviathan
Sidney Mornington

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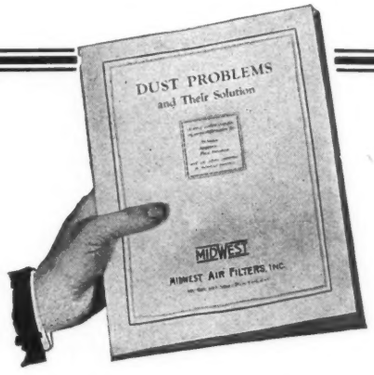

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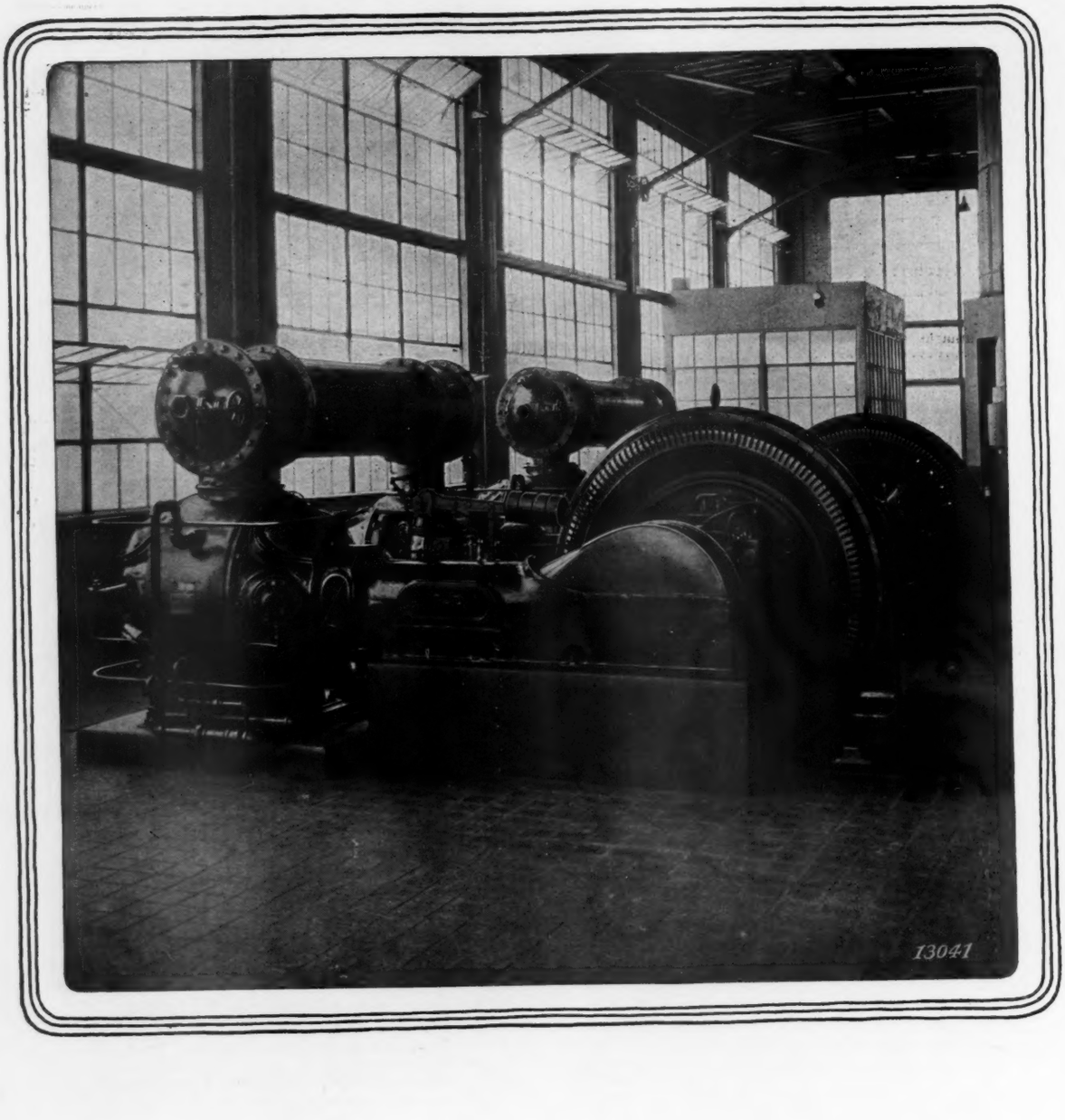

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SEPTEMBER, 1923

How Rubber Is Manufactured To Suit Many Purposes

In Transforming the Crude Substance into a Variety of Commodities Compressed Air is an Essential Aid

By S. G. ROBERTS

RUBBER, as we know it in our daily contacts, is what it is because it isn't what we think it is.

One of the objects of this article, therefore, is to explain away a paradox which is the outgrowth of a widespread but erroneous belief that the more pure rubber there is in an article the better must be that commodity for practical use.

With few exceptions, most rubber goods would be quite unfit for the services to which they are put if they were not liberally compounded of other ingredients, and, as a matter of fact, the commodities we are going to describe contain anywhere from 100 per cent. down to 40 per cent. of rubber. In short, rubber would not be the blessing it is if unmixed with other substances. Generally speaking, rubber is valuable because it is capable of binding various materials together and of imparting to them at the same time some of its own unique qualities. By way of instancing some of the extremes to which this is carried, let us cite a few examples.

The surgeon's glove, which is little more than a transparent film of pure rubber, is not made to stand rugged wear but to serve for a brief while merely as a barrier against germs while leaving the dexterous fingers unhampered in their delicate work. On the other hand, gloves for the X-ray operator must be radically different in order to safeguard the enveloped hand from the penetrating radiations of the Roentgen tube. Accordingly, gloves for this purpose must be made of a material largely compounded of lead so as to be resistant to these rays and to prevent them from causing serious and possibly withering burns.

Again, the hot-water bottle, the ice cap, the tennis ball, the hand ball, or the atomizer bulb must be fashioned from sheet rubber especially compounded to meet particular requirements. Broadly stated, this is pretty much the case with a well-nigh endless variety of articles turned out by the rubber manufacturer. All these products have but one thing in common—that is, some rubber in their get-up which, to play the part assigned it, must be associated with sulphur and undergo the process termed vulcanizing. In the absence of either of these, rubber would have an extremely limited field of usefulness and could not play the diversified part it now does in daily life.

FAMILIAR as rubber is to most of us in its manifold applications, nevertheless comparatively few of us have more than an elementary knowledge of the means employed to transform the crude material into forms suited to our diversified needs.

Indeed, it is probably no exaggeration to say that there is no other substance in common service about which we are more generally ignorant than we are of rubber and the processes followed in making it fit to serve numberless purposes in our daily lives.

The present article has been prepared—after visiting one of the truly monumental plants of the industry—in the belief that there are thousands who would be interested in learning how are manufactured some rubber goods which come close to us because of what they contribute to our comfort, our convenience, and our health, as well as to the delight of our periods of recreation.

Crude rubber will stretch but it won't retract. The curing process incident to vulcanization serves to impart pliability to the rubber and to remove at the same time any excess of the sulphur content. Strange as it may seem, no one has yet been able to determine exactly the right amount of sulphur which must be added to the rubber to bring about a proper degree of vulcanizing, and, therefore, the practice is to err on the right side and to use more than is necessary—getting rid of the superfluous sulphur by the application of heat throughout a suitable period. And here it may be said that success or failure in the manufacture of rubber goods depends to a great extent upon the nice regulation of the temperature and the length of time it acts.

Just how the admixture of sulphur and the application of heat produce a new compound, vulcanized rubber, need not be entered into here because it would involve technicalities which might prove tiresome. Even so, vulcanizing and curing, often called "cooking" in the trade, demand skill and expert supervision lest the commodity suffer or be rendered utterly unfit for market. With this prelude, let us proceed with the story we have to tell—how The Seamless Rubber Company, Inc., at its great plant in New Haven, Conn., turns out a variety of rubber commodities for the home, the hospital, and the physician, not to mention specialties in the form of football bladders, toys, etc.—a matter of 3,000 different articles.

Even though the milky sap drained from the trees of the tropical wilds or from the plantations of *Hevea* in the Far East may be pure at the start, either by accident or intent impurities get into or are hidden away in the crude rubber shipped to the distant manufacturer. The first step, therefore, at the factory in preparing this raw material for use is to "crack" and to wash it so as to get rid of all objectionable foreign substances. As might be expected, the apparatus which wash and macerate the rubber are ponderous and powerful affairs and, for the best of reasons, are located in the basement of the building at New Haven where it is practicable to provide them with firm foundations. The mastication or the maceration treatment is one of the most important functions of the mill room, and, depending upon how the work is done, the basic material may be either made or ruined.

After the cracking and washing machines have sheeted and cleaned the rubber, the sheets

The fabrication of handmade rubber gloves calls for highly skilled operatives. These gloves are extensively used in trades where corrosive acids have to be dealt with.

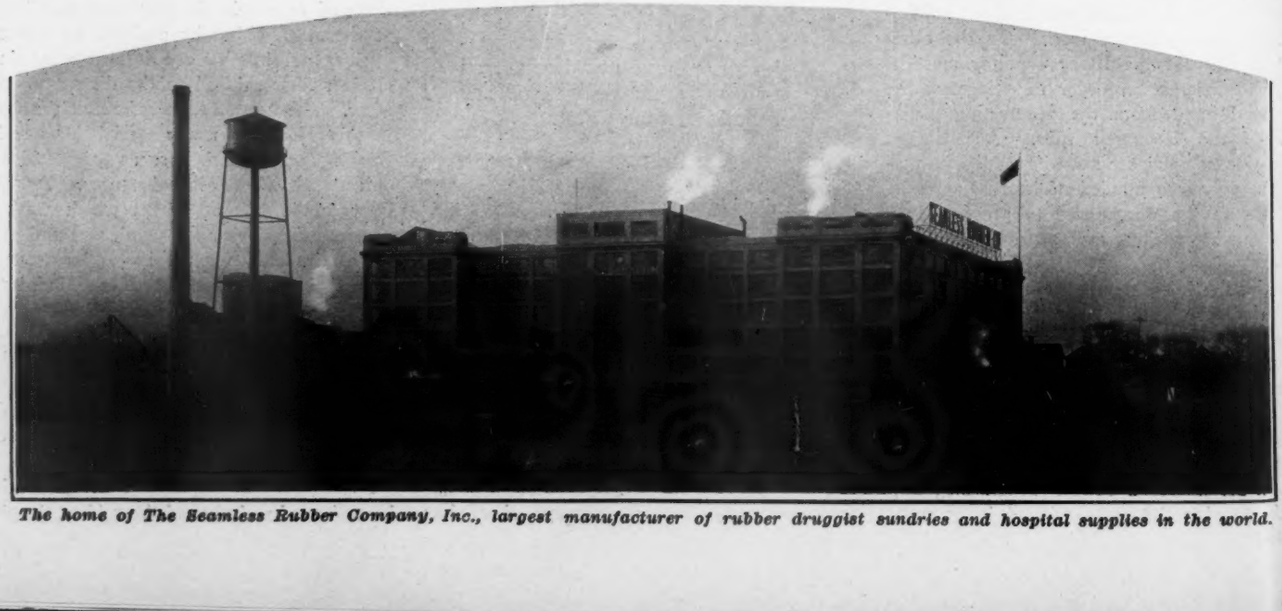
Making marine millinery. These hats and caps for feminine bathers are largely handmade and require no little artistic skill in putting them together and in trimming them.

are carried to a dry kiln where they are hung up and exposed to a temperature of 160° F. for a period of 24 hours—the air within the hermetically sealed kiln being circulated the while by electric fans. When thoroughly dry, the rubber is then taken to the compounding department where it is weighed and where the different ingredients to be added to it are set aside in a pan. Both the rubber and the other materials then go to the mills, which are also big, heavy machines, and there the various substances are well mixed. The rubber compounds which are thus produced are handled primarily in 100-pound batches, and in the course of a day 25 of these batches are dealt with on one set of rolls. Owing to the nature of the ingredients and their varied properties, the operators in charge of the mill room must be experienced and know just how the different compounds should be mixed and manipulated.

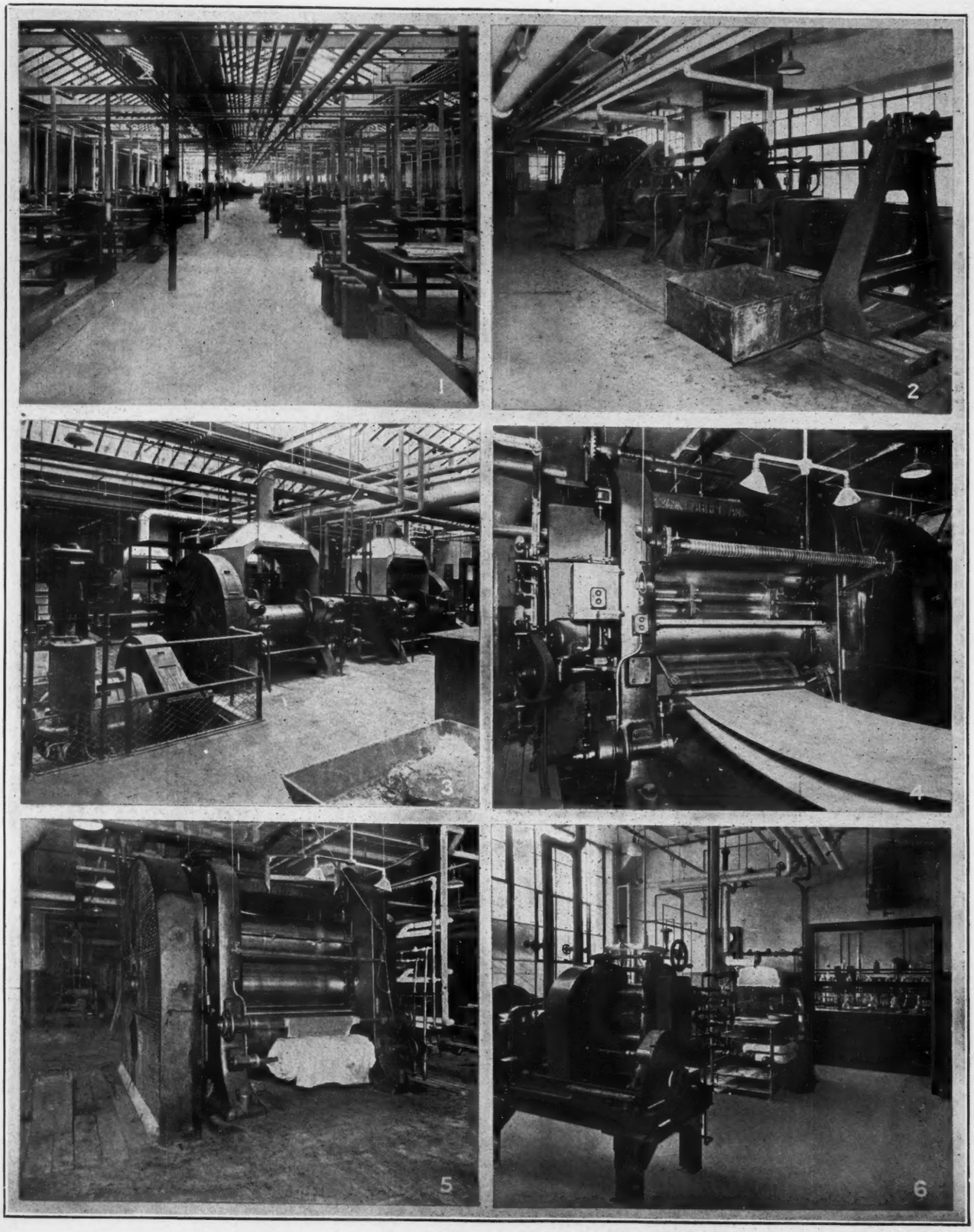
To avoid confusion, let us follow the various steps involved in fabricating a hot-water bottle, for example. Having done this we shall then find it easier to understand the activities in other departments of the plant. The compounded rubber that has been stored is withdrawn from the stock room and put through the rolls of a warming mill, whence it is fed to the calender. From the hot and heavy cylinders of the calender, the compound issues as a sheet of predetermined width and thickness that is incidentally scored or partway cut longitudinally so that it will readily tear into strips of suitable breadth for the making of the bags or bodies of the hot-water bottles. This sheet of rubber is run directly from the calender onto cotton drilling, dusted with flour or starch, so that the rubber fabric can be rolled for subsequent use without the risk of troublesome adhesion. The rubber can be readily stripped from the textile.

The material is delivered in this condition to the press room within which is set up an imposing array of hydraulically operated steam-heated presses which shape the sheet rubber through the joint application of heat and pressure. To be specific, the rubber fabric is laid over two sides of a form plate or core patterned upon the contours of a hot-water bottle, and this plate is held nicely suspended within a two-piece mold, the opposing halves of which are brought together first by a hydraulic pressure of 40 pounds, obtained from the city water mains, and then by a 600-pound pressure developed by the plant's hydraulic system. At the same time, the press is heated by circulating steam at a pressure of 80 pounds, and the resultant temperature serves to give the rubber its final cure. The heat and the pressure cause the rubber compound to flow and to fill the interstices of the mold, thus completing the shoulders, the neck, and the sides of the seamless bottle at one operation. Through the open bottom the core plate is withdrawn; and this aperture is subsequently sealed and a tab attached at one and the same time by a second press.

After leaving the second press, girls trim away with scissors any excess material; and with this done the bottles are washed in soap and water before they are tested for tightness. This test consists in plugging the bottles with a stopper, through which compressed air can be blown into them prior to immersing them in a tank where bubbles would promptly betray any leak. All sound bottles are then varnished by dipping in an approved solution, and then they are hung on horizontal rods carried by a

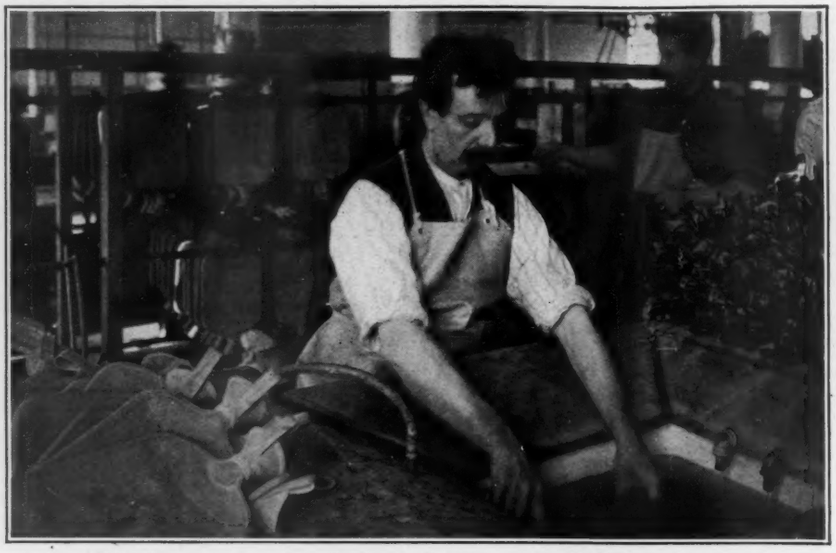


The home of The Seamless Rubber Company, Inc., largest manufacturer of rubber druggist sundries and hospital supplies in the world.



Photos Courtesy Aberthaw Construction Company.

Fig. 1—In this press room water bottles are formed and cured in each machine at a single operation. Fig. 2—Cracker and washer line. These machines sheet the crude rubber and remove all impurities. Fig. 3—After crude rubber has been purified various ingredients are added and thoroughly combined in these mixing mills. Fig. 4—The delivery side of a calender. When thoroughly mixed and warmed the rubber is sheeted to gage by means of a calender. Fig. 5—The rear side of a calender. Here is shown some of the rubber on a cloth upon which it is laid and rolled to prevent the layers from sticking together. Fig. 6—A glimpse into the chemical laboratory. Because of the nature of the trade served, an exact knowledge is required of the composition of all the ingredients worked into the various commodities.



Every article that is expected to hold any liquid in service is filled with compressed air and tested for tightness by immersion in water.

slow-moving conveyer where, during a journey of twenty minutes' duration, they are dried.

As long as we are dealing with the manufacture of a commodity that does, indeed, come close to many of us, it might be worth while to caution a prospective purchaser not to object to a hot-water bag that appears dull because of a powdery coating. That dust, or "bloom" as it is known to the trade, is sulphur and indicates that the rubber compound has not been overcured during vulcanizing. Further, a hot-water bottle will prove more durable if kept in the dark, and it will also retain its elasticity longer if squeezed by hand at frequent intervals. Don't abuse it by filling it with boiling water, for the excess heat continues a treatment which the maker purposely halted at the proper stage.

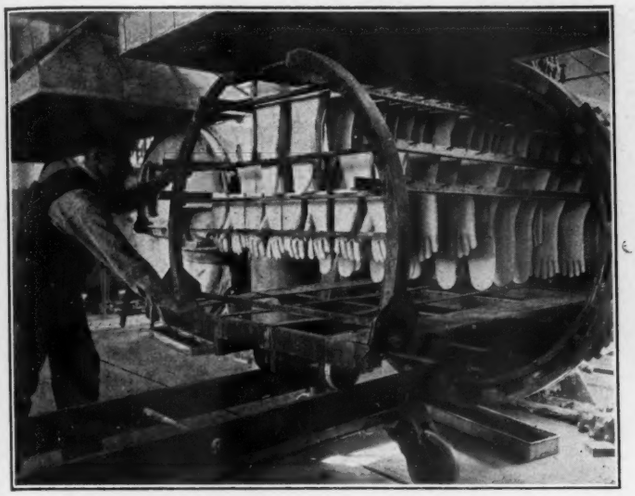
The system of automatic heat control employed for all the vulcanizing chambers utilizes compressed air for opening and closing the valves which admit steam to the heating coils. This function of compressed air is an important one and becomes clear if we stop to consider for a moment the temperature ranges employed. For example, in the dry heat boxes the temperature is built up progressively to 250°F. in the course of 5 hours and is then held at that point for 2¼ hours, while in the cylinder vulcanizers the temperature is gradually brought to 280°F. in ½ hour and maintained at that point anywhere from 1 hour and 25 minutes to 2 hours, according to the product being cured. Therefore, should the supply of compressed air fail a serious loss might result. In fact, as one of the experts of the plant has expressed it: "Compressed air is vital to our operations, and should the air plant break down most of the factory would be brought to a standstill."

Another section of the testing department. At the rear and right is a suspended cage covered with wire netting where the inflated bladders for footballs, etc., are left for 24 hours to prove that they are satisfactorily airtight.

Let us leave for a moment the serious side of the plant's activities and see what is done under the same roof to add to the pleasurable side of life. In preparation for the work of this department, the mill room has produced sheet rubber "marbled" with many of the colors of the rainbow, and now we shall learn how the bright-hued balls are made which are such a delight to children. Many grown-ups have, no doubt, wondered how these lively, bouncing spheres are fashioned, and a look into this corner of the factory will solve the puzzle.

Again, we have a room occupied by numerous presses, as was the case where hot-water bottles were being fabricated; but the ball presses operate quite differently—they are partly functioned by a vacuum which is maintained by a small indefatigable air compressor hidden away in a dusty corner where it works in reverse. The upper and the lower opposing tables or faces of the hydraulic presses carry a symmetrically arranged series of hemispherical cavities, and in the bottom of each of these is a connection with the suction system. When a sheet of rubber is laid upon either of these steam-heated plates and the pull of the vacuum machine is brought into play then the rubber is drawn snugly into the recesses and held there. This procedure is repeated in the case of the opposing face, and then the two plates are

Here water bottles are subjected to final inspection and cleaning.



Loading a vulcanizer with gloves. Here is where the rubber goods receive the treatment known as "the cure." This is a heat treatment in which the temperature is automatically controlled by compressed air.

An array of porcelain forms on which rubber gloves are built up by successive dipping. Between periods of service these forms are cleaned by compressed air.

brought forcibly together by the application of hydraulic power which causes the rubber to flow and to weld the companion halves together. But before this is done, there is dropped into each lower hemisphere a pellet or "gas tablet" with a small quantity of liquid. These tablets and the fluid, under the action of the heat of the press, generate sufficient gas to inflate the balls and to hold the shells of the latter firmly against the walls of the molds, thus producing perfect spheres charged with a gas which keeps them distended and contributes to their resilience.

The number of balls made at one time by a press, depending upon the size of the balls, ranges from 4 to 28; and it is in this manner that tennis balls are formed before they are given their felt covering. Certain syringe and atomizer bulbs are turned out in much the same manner but with this exception: the sectors of the bulbs are assembled by hand and lightly "tacked" together by a few dabs of rubber cement. Next, a small amount of water and alcohol is dropped into each bulb before it is placed in a suitably shaped mold in a hydraulic press, where the heat causes the alcohol and water to vaporize and to force the rubber snugly against the contours of the molding cavity while the several sectors are being firmly united by heat and a pressure of 1,300 pounds. The heat of the mold also helps to cure the rubber. Compressed air is used after each operation of the press to clean the molds.

Raw edges or "fins" on atomizer bulbs are removed by buffing, but similar fins on balls are got rid of by rolling the balls in a tumbling barrel. When the balls have been made satisfactorily smooth by this procedure they are then polished or varnished in another tumbling barrel. The syringe or atomizer would be incomplete generally without rubber tubing, and this commodity is produced through the agency of a press of special form in which the rubber is simultaneously subjected to heat and to pressure. Sheet stock—compounded of rubber, coloring matter, and suitable mineral ingredients—is fed the tubing mill, where it is forced through a heated die by means of a worm. Steam, at a pressure of 80 pounds, keeps the head of the die cylinder at the needful temperature. Under the impulse of the worm, and rendered fluid by the heat, the rubber flows around the circular die which is centrally held in a short cylinder, and in this fashion the tubing grows. An attendant takes the tubing as it issues from the machine and cuts it into suitable lengths on a near-by table. The tubing is filled with powdered soapstone and also packed in trays filled with the same stuff before being placed in the vulcanizing chamber. The soapstone serves the double purpose of protecting the tubing while exposed to the curing heat and of preventing the rubber lengths from sticking together. Subsequently, the tubes are blown free of the dust by compressed air.

Rubber used for the making of tubing is taken from the warming mills and run through a tubing machine. The operator cuts the tubing to prescribed lengths and rolls one end of each piece.

The foregoing process of vulcanizing is what is termed dry curing, and is the one followed in treating many kinds of goods manufactured by The Seamless Rubber Company, Inc. After removal from the enveloping flour, powdered pumice, soapstone, etc., the commodities must be cleaned, and this is usually accomplished by exposing them to streams of compressed air. We shall see presently that this same handy and helpful medium performs other necessary services.

Interesting as it undoubtedly would be to describe how rubber gloves are put together when made of material having a cloth insert, and absorbing as it would be to many to learn of the work of the rubber-millinery department, where bathing caps or hats of a highly decorated character are produced by the skilful fingers of young women, still we shall have to leave these subjects with the simple explanation that all these commodities are produced from rubber compounds which have first been made into sheets of differing thicknesses, of divers colors, and of special qualities in the mill room. We might mention, however, that the bathing caps are vulcanized by exposing them for a given period at a prescribed temperature to sulphur fumes, during which the heat opens the pores of the rubber and sulphur is deposited therein. When this cure has been completed, the caps are tumbled in barrels charged with ammonia fumes.

As our space is limited, we shall have to confine the rest of our story to an outline of what takes place in an annex of the plant, where the somewhat risky work of manufacturing rubber-dipped goods is

carried on. As the term implies, the commodities are made primarily by successively dipping forms into a rubberized fluid, and thus building up gloves, for instance, layer by layer until they have attained the needful thickness. In the dip-goods department are manufactured medicine droppers, nipples, finger cots, bathing caps, surgical gloves, and rubber gloves for various purposes.

The rubber compound, which has been previously milled, is mixed with naphtha, benzol, etc., and churned mechanically for an average period of 24 hours. When this is ended, the fluid is pumped to tanks and held there anywhere from three days to three months, depending upon the character of the mixture and the nature of the service for which the goods are to be used. The longer the stuff is allowed to age the better, because impurities can settle to the bottom of the tanks and air can work its way out. In short, a purer and a more uniform mixture is obtained in this manner. The forms for nipples and medicine droppers are made of aluminum, those for gloves are of porcelain, while cap forms are of wood. In any case, numerous forms are mounted on a carrier so that they can be dipped into the fluid, withdrawn, and then suspended to dry for a while before dipping again. In making nipples or droppers the reel or machine will hold more than 21,000 pieces, and eight dips are required to finish each piece—an hour being allowed to elapse between immersions. All dipping forms are washed after each cycle of use and are blown clean by compressed air. Similarly, the platforms of the trucks employed in the glove room are dusted by this handy medium.

Surgical gloves are made of pure rubber mixed with a solvent which evaporates after they have been finished. High-grade, seamless rubber gloves of a more enduring sort for other purposes are produced by dipping porcelain forms into a somewhat different mixture. When these gloves, after several dippings and alternate dryings, have attained the needful thickness, girls trained in the work trim and roll the cuffs of the gloves. The gloves are then immersed in acid, still on the forms, and thereafter dried while moving along in a conveyer for a short period. Next, they are doused in fluid starch which is allowed to dry as the rubber-covered forms journey in a second conveyer to the department where the stripping takes place which turns the gloves inside out. When the gauntlets are stripped from the china hands their exterior surfaces are covered with dry starch. Finally, they are turned right side out by means of compressed air, and then put in a tumbling barrel for a short time to give them a silky finish.

When surgeons' gloves have received their last drying they are trimmed in the manner already described and subjected to a vapor cure. After the cure they are stripped from the forms and turned right side out. Formerly this operation was performed by hand, and even with nimble-fingered operatives this took considerable time. Now, the reversing process is effected by compressed air; and a single worker can turn hundreds of gloves in an astonishingly short interval. It might be recalled at this point that compressed air is also used to inflate football bladders for testing. So charged with air they are left in an open bin for 24 hours, and if no serious deflation take place during that period they are deemed sufficiently tight. A leak can be detected in this manner which might escape observation if the balls were tested only by immersion.

In this department the various parts of atomizers are brought together and assembled ready for shipment.

Atomizer nozzles, pipe stems, cigarette holders, etc., of hard rubber are polished on buffing wheels.

In order to facilitate the handling and the distributing of materials and products in the course of manufacture, the factory is equipped with numerous air hoists; and, as might be expected, the up-keep and the developmental needs of such an establishment demand repairs, alterations, and improvements in one direction or another. Pneumatic tools are employed extensively in the execution of this work.

For the sake of those interested in statistics, we might mention that this great plant, designed and erected by the Aberthaw Construction Company, began its active career in October of 1920. The main building has a floor area of more than 5½ acres; 1,500 people are engaged within its walls; and during 1922 a matter of 1,624 tons of rubber compounds was fabricated into many kinds of goods. Back in 1877, the New Haven company attained prominence by bringing out the first genuine seamless nipple for the feeding of infants; and the factory at that time was a modest affair located in Naugatuck, Conn. Success in that departure, which meant much to the comfort of babies and to the peace of mind of parents, led subsequently to the making by kindred processes of other rubber commodities. Thus, from a truly infant industry has grown an enterprise of magnificent proportions.

Mechanically Evaporated Fruits Fast Displacing the Sun-Dried Product

Compressed Air Does a Useful Work in This Industry in Maintaining a Uniform Heat in the Evaporators

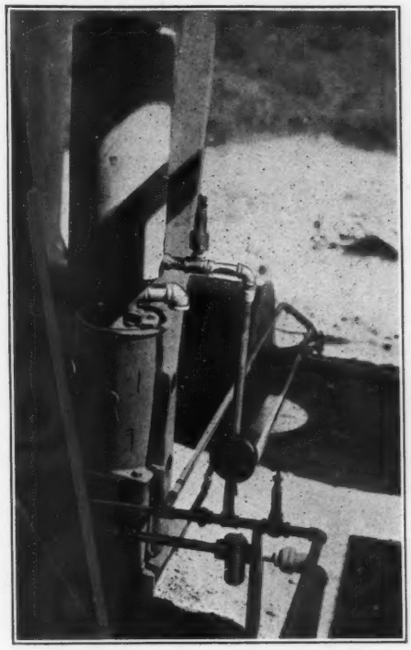
By NORMAN LOMBARD*

COMPRESSED air is playing its part in the far western states in the evaporation of fruits and vegetables—a brand-new industry which is exceedingly active and operating in competition with the old-fashioned methods of preserving foodstuffs by sun-drying and canning. That the industry is no longer in the infant class will be realized from the fact that California produces over 200,000,000 pounds of prunes per annum, with the prospect of nearly doubling this output within the next five years.

A broker recently received an order for 100 carloads of evaporated prunes to be shipped to London, England. While this is but one commodity, thousands of tons of other products, such as apples, peaches, apricots, grapes, tomatoes, pumpkins, etc., are evaporated and sent broadcast.

The modern process of evaporation is as different from the primitive method of drying as the present-day automobiles differ from those of twenty years ago. Apples dried by the up-to-date method can be used any time within a year or two, and will make apple sauce as fresh and palatable as that from green apples. Evaporated pumpkins turned into pumpkin flour can be used in all seasons of the year for the making of deliciously fresh pumpkin pies. The explanation is found in the control of the humidity and the temperature during the process of evaporation, which is accomplished by recirculating all or a portion of the drying air, as well as in the control of the passage of the air over the product being dried by means of fans and dampers.

Not only are the scientificially evaporated fruits and vegetables competing with the sun-dried products and those dried by the old methods, but they are also strong rivals of canned goods for the reason that the process is much less expensive. The containers in which the dehydrated products are packed for home consumption are much cheaper and lighter; the foodstuffs also weigh less because of the absence of water; and the costs of transportation, storage, and handling are, therefore, greatly reduced.



Compressed air, provided by a small Ingersoll-Rand compressor, sprays the fuel into the furnace of the oil-burning evaporator plant.

Compressed air does not play a part in the actual drying but it does help to maintain the uniform heat that is required. This heat is usually produced by the burning of crude oil, which is atomized by compressed air. Various means of securing an even heat in the furnace are in use by different manufacturers, but in the case of the evaporator plant with which the writer is most familiar a combination was effected that has proved thoroughly satisfactory during a period of several years.

In the evaporator of the Progressive Evaporator Company, an Ingersoll-Rand air compressor, driven by belt from the main line shaft, is employed. This shaft, which is driven by a steam or gas engine, or by an electric motor, also drives the circulating and exhaust fans. Air at from 15 to 20 pounds pressure per square inch is used; and the compressor is suitably fitted with an oil pump which delivers the fuel to the burner at a pressure of 25 pounds to the square inch. The pump is provided with a by-pass for a return flow of the oil to the tank, and with a suitable relief valve to permit close adjustment to the required pressure.

Air and oil, under the specified pressure, are delivered to a Witt burner of special design which consists of a tube, inside of which there is another tube. The inner tube is perforated, and the oil passes through this tube and its perforations, while the air flows through the space between the inner and the outer tubes and vaporizes the oil—forcing it through a slotted nozzle into the furnace. The fire so maintained is of such intensity that one nozzle will furnish sufficient heat to evaporate the moisture from fifteen tons of prunes per day. So effective is the combustion that, with fuel oils at Pacific-coast prices, evaporating plants have been operated at a fuel cost as low as 50 cents per ton of green product. As a result, the cost of evaporating many foodstuffs by the new method is actually less than that of sun-drying them—the saving being largely brought about by doing away with the labor needed to spread the product and to take care of the trays in the open.

*President, Progressive Evaporator Company.

Trays filled with prunes being shoved into the evaporating house for drying.

The dried fruit being shifted from a tray into boxes preparatory to shipping.

The mechanical evaporation of fruits and vegetables is rapidly gaining ground. The process, from a hygienic standpoint, is a big improvement over the old, unsanitary method of drying in the open air, where dust and dirt are much in evidence. Competent authorities have prophesied that in the course of a few years the vast sun-drying yards in California will be a thing of the past, and that

The old, unsanitary method of drying prunes in the open air.

practically all the drying will be done by mechanical means.

The product treated in an evaporator, standing as it does for hours at a temperature of 160° F., arrives at a condition which the doctors call "A sterile," that is to say, absolutely free of all germ life. The result is a foodstuff that is pure and wholesome; that has splendid keeping qualities; and that is heavier, sweeter, and more nutritious because it is free of the fermentation which is bound to take place where the fruit is allowed to remain out in the open air through warm days and cool nights for a matter of from two to four weeks.

Although the 1923 sun-drying season was the best in many years, hundreds of growers preferred to have their products dried in the evaporating plants rather than in the sun. Numerous canneries found it advantageous to have some of their fruits mechanically evaporated; and, as a result, the growth of the industry, and the use of compressed air in connection therewith, has, unquestionably been given a tremendous impetus.

ARTESIAN WELLS TO MAKE A DESERT PRODUCTIVE

EUROPEAN engineers are of the opinion that large areas of the Sahara Desert could be made fertile by boring Artesian wells like those now in use in arid sections of Australia.

Gaston Imbeaux, Chief Engineer of the Public Works Department of the French Government, points out that the sinking of wells has made that commonwealth one of the greatest pasture countries in the world, and that by adopting similar methods in the Sahara great stretches of that dry region could surely be transformed into grazing lands for sheep, etc.

There is undoubtedly an abundant supply of water beneath the vast sand wastes of Africa; and Monsieur Imbeaux declares that "if the French authorities would undertake to sink shafts to those subterranean wells, the future success of the projected trans-Sahara railway would likewise be assured."

PROBLEM OF "FISH SCALING" ENGAGES CERAMISTS

BECAUSE of the intense heat radiating from the furnace—with a temperature on the inside of from 1,400 to 1,700° F.—the two ceramists of the United States Bureau of Standards, shown in the accompanying illustration, have divested themselves of their shirts. Yet, in the manufacture of enamelware, which is being undertaken on a small scale in this Government laboratory, a temperature of 1,700° F. is relatively low when it is taken into account that heat in the neighborhood of 2,500° F. is needful to melt the raw materials that make up enamels.

The sweltering atmosphere in the laboratory where the scientists are toiling is troublesome, for if a single drop of water or moisture finds lodgment on a plate, cooking utensil, or other piece of enamelware there will be left an imprint or defect for all time. Seriously, the ceramists in question are studying the problem of how to prevent "fish scaling" of enamelware. The housewife who finds tiny bits of enamel cracking from the surface of the ware in her kitchen, etc., can appreciate the efforts of the Government Bureau to correct this tendency. It has been stated that this defect has not only cost the industry much on account of rejected goods but that it has proved to be the most difficult obstacle to overcome.

The investigators have already progressed sufficiently to determine the cause of fish scaling of enameled metalware, and they attribute it to a difference in contraction. In other words, the metal and the applied enamel do not shrink coincidently after the goods leave the high-temperature furnaces. According to Dr. W. A. Hull, of the Bureau of Standards, this counteracting tendency may be overcome by developing enamels having a coefficient of expansion more closely approximating that of steel and iron. So-called fish scales commonly take the shape of a half moon, and are thus readily distinguishable from chips broken off by impact or other rough handling.

Mechanically treating the metal surfaces before enameling has likewise resulted in minimizing fish scaling. This was proved by the fact that untreated portions of enameled vessels developed flaws whereas those put through the preliminary process were free from defect. All this goes to show that the investigators are on the right path; and in prosecuting their research work the Bureau of Standards has enlisted the coöperation of manufacturers of enamelware and producers of sheet steel.

Studying the problem of "fish scaling" which has caused so much trouble to manufacturers of enameled metalware.

America's Queen Of The Seas: The S. S. Leviathan

With This Splendidly Reconditioned Ship the United States Aspires to Set a New Pace in Transatlantic Passenger Service

By SIDNEY MORNINGTON

AMERICA'S brave bid for the transatlantic "blue ribbon" is something that none of us can afford to view with indifference.

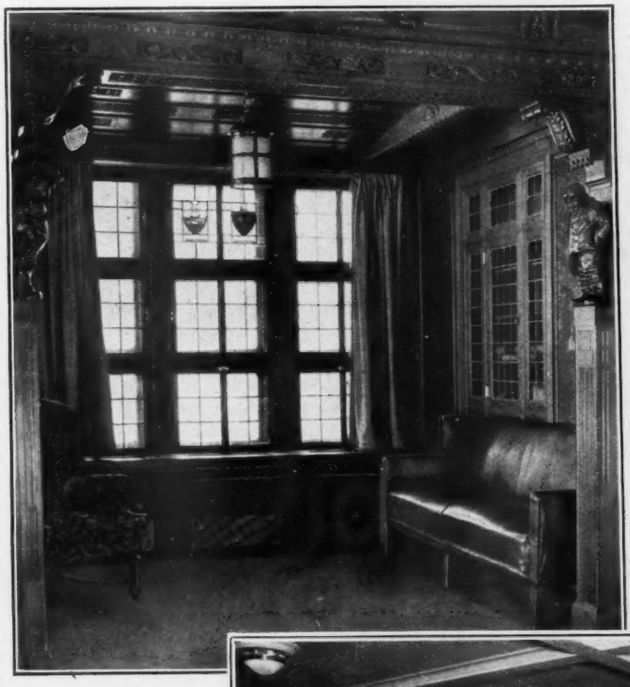
Apart from restoring to active service a craft that played an important *rôle* in the World War and had to do intimately with the safe conduct of more than 100,000 of our fighting men, the rehabilitation and the incidental betterment of that erstwhile German liner is a technical achievement which reflects great credit upon the skill, the capabilities, and the courage of the men responsible for this monumental piece of work. They wrought successfully where alien critics declared they must certainly fail.

Whether or not we choose to look upon the *Leviathan* in her newborn field of usefulness as a symbol of retribution or the irony of Fate, we cannot be unmindful of the fact that she represented nine years ago the climax of a people inspired by the imperial dictum, "Our future lies upon the sea." By a turn of the wheel of Fortune, that monster craft, which then typified the acmé of Teuton engineering skill, now carries the Stars and Stripes and steams forth with increased capabilities and well-fitted to head a merchant marine which ought to be second to none.

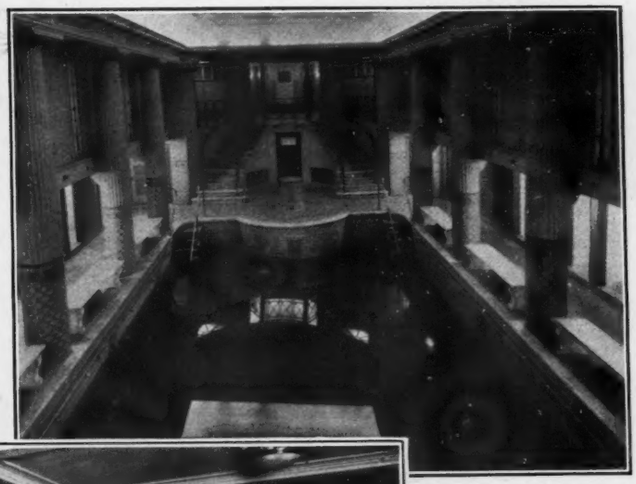
As the *Vaterland*, the *Leviathan* was built by the well-known German firm of Blohm & Voss; and on the 14th of May, 1914, she left Hamburg on her maiden voyage to the United States—reaching New York seven days later where she was justly acclaimed the finest existing example of marine architecture in her particular class. A career that promised to be a splendid and a profitable one was brought to a sudden halt a few months later—to be exact on August 1, when the black-white-and-red ensign was no longer free to fly over a fleet that had hitherto traced its course well-nigh everywhere upon the Seven Seas. On that memorable date, the *Vaterland* was in the port of New York, and there she remained interned until the United States entered the conflict.

Rumor had it at various times after April 6, 1917, that the officers and crew of the *Vaterland* had been guilty of sabotage, and, therefore, that the task of the United States Navy in putting the ship into seagoing condition was all the harder. It has been officially stated that no malicious damage had been attempted by the Germans, although parts of the steamship's machinery had been dismantled and scattered. In the case of other Teuton craft the story was a very different one. The work of overhauling the *Vaterland*—she was not called the *Leviathan* until September 6, 1917—so that she might be utilized as a troopship necessitated many months of hard labor and ceaseless scrutiny after that vessel was taken over by the United States Government authorities. As can be readily appreciated, nothing could be taken for

A cosy corner in the smoking room. Note the carvings of the old "sea dogs" which adorn the flanking columns.



The swimming pool aboard the "Leviathan." The pool simulates the luxury and the architectural beauty of a Roman bath.



The tea room is a center of attraction where time may be spent pleasantly over "the cup that cheers" or in a game.

granted, and an exhaustive examination had to be made of every part of the craft so that she might be safe and entirely fit for the vitally important service to which she was to be put. How well and competently that work of preparation was done is a matter of record.

On November 16, 1917, the *Leviathan* was reported ready for sea; and in the forenoon of the following day she backed out of her slip and headed down the North River for a trial run to West Indian waters. That trip was a success; and the ship's performance was ample evidence of the resourcefulness, the energy, and the skill of the men that had labored long and hard to condition her. Before the sun was up, on December 15 following, the *Leviathan* steamed away on her first run across the Atlantic as a naval transport—carrying on that maiden and memorable voyage no fewer than 7,254 troops in addition to her operative personnel of more than 2,000 men.

Captain Herbert Hartley, Commander of the "Leviathan," looking forward from the bridge through the "clear-view machine"—something new in navigational aids.

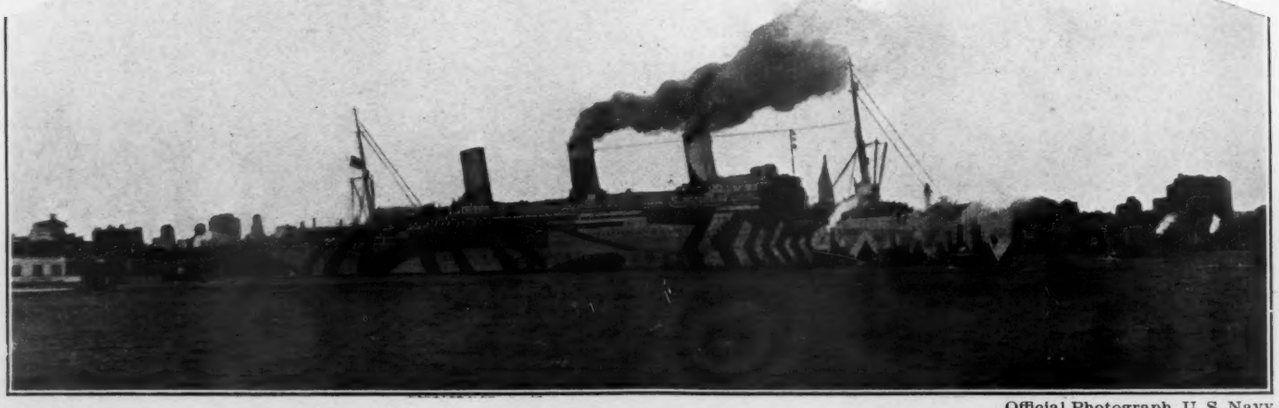
Needless to remark, the various trips of the *Leviathan* abounded with thrills, and it will probably always be a source of wonder why that enormous target escaped the sinister missiles of hostile submarines. We are told: "Only two enemy periscopes were seen in the ten voyages made by the liner before the armistice. The first occurred in the Irish Sea on her initial voyage in the midst of the destroyer escort. After the discharge of a number of bombs nothing was seen of the submarine. On her fifth voyage, just entering Brest in May, 1918, an enemy submarine miscalculated and showed her periscope off the *Leviathan's* quarter. The ships' guns handled this situation, and the periscope was not seen again."

On her ten eastward runs to France prior to the cessation of hostilities, the great transport carried a total of 94,183 troops—the largest number, 10,867, being moved to Europe on the ship's seventh trip. Apart from getting fighting men safely and speedily across the Atlantic, it was likewise essential that those soldiers should be fed well and promptly three times a day. It is claimed, and no doubt justly, that the Supply Corps of the Navy did remarkably efficient work in providing for the subsistence of the troops while aboard the greatest of our transports. It is authoritatively stated that, by reason of carefully planned arrangements, 9,000 men were given their food within the amazingly brief period of 67 minutes.

No wonder the *Leviathan*, known affectionately by thousands as *The Big Train*, the *Levi*, and the *Levi Nathan*, was very properly considered the backbone of our transport service. After the armistice was declared, this immense and commodious "ocean ferry" was the means of bringing back quickly and in comfort many thousands of our more or less grievously wounded and suffering "doughboys." On one of her westward runs she had aboard more than 12,000 army men and women—in short, counting her operating personnel, there were over 14,000 souls in transit! She made the journey of substantially 3,500 nautical miles in less than seven days. It is interesting to recall, in connection with the swiftness with which the steamer traversed the Atlantic, that when the demands for troops were greatest in the summer of 1918 the *Leviathan* made a complete round trip in 16 days and 23 minutes. Well, indeed, did she win her nickname of *The Big Train*.

With her war work done, the *Leviathan* became pretty much of a white elephant on the hands of the Government. What to do with her was a puzzling question, especially as the United States Shipping Board was for a long while unable to arrive at any definite policy concerning the peacetime employment of the vast fleet at its disposal. In equipping the *Leviathan* for transport service she had been so radically modified in the matter of accommodations for passengers that much would have to be done to her to restore her to usefulness in her former field. Not only that, but she had deteriorated in numberless ways while playing the part of *The Big Train* and also while lying idle subsequently at her Hoboken pier. In brief, she could be rehabilitated for high-class passenger traffic only by thoroughly overhauling her from keel to masthead. There were seemingly insurmountable obstacles in the path of such a course.

Built as she was in Germany, there were no plans of the *Leviathan's* hull and machinery available on this side of the Atlantic; and



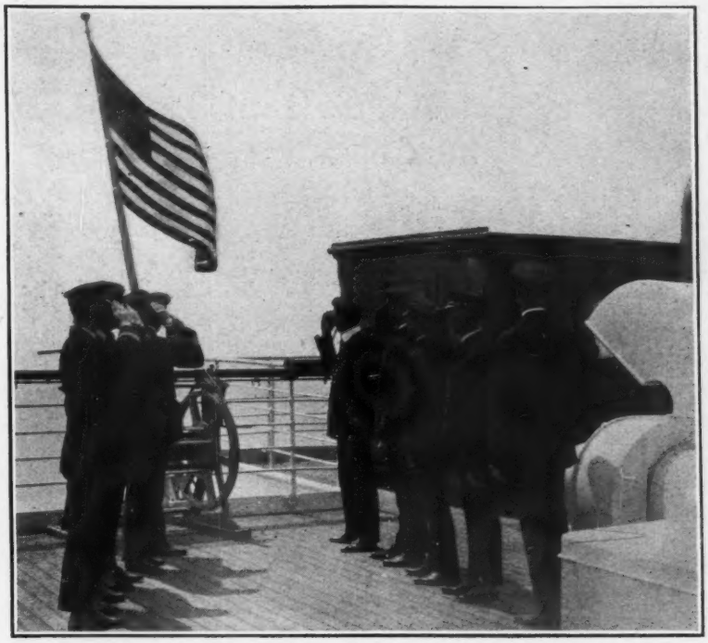
Official Photograph, U. S. Navy.

The "Leviathan" as a transport and wearing her wartime camouflage.

the Germans, when they learned that it was our desire to recondition the big craft, not illogically concluded they had us at a disadvantage and could make us pay dearly for the information we desired. They overreached themselves when they demanded $1,000,000 for the plans. The United States Shipping Board refused to be gouged, and decided to do "the impossible" by going ahead without the original drawings and specifications.

It would be a very difficult thing, indeed, to explain to the layman the bewildering complexities of a giant ocean liner, or to make it plain how a vast multiplicity of apparently unrelated features, facilities, and diversified apparatus must be coördinated so that that titanic organism of man's fashioning can be made to function properly in all of its departments. It is enough for us to say that before the reconditioning of the *Leviathan* could be taken in hand it was absolutely necessary that she should be measured throughout and in detail so that new plans and new specifications could be drawn up for the guidance of the shipyard which should essay to prepare her for the transatlantic trade. So far as we can learn, nothing of this character and magnitude had previously ever been asked of naval architects and marine engineers; and the shipbuilding fraternity at large—both in America and in Europe—recognized the novelty and the enormity of the task.

This extremely exacting and highly technical work was assigned to Mr. William F. Gibbs, for years the chief constructor of the International Mercantile Marine Company, who had been intimately identified during the World War with the Federal Shipping Control Committee. Mustering to his aid an organization of something like 150 men, familiar with ships and marine engines, Mr Gibbs and his assistants measured every foot of the *Leviathan's* intricate get-up inside and out—and, hard as it was to reach some parts of her structure, the work was done with painstaking persistence and with amazing accuracy. From this accumulated data, complete new plans were drawn and comprehensive specifications drafted so that a prospective bidder could gage the magnitude of the job and submit a lump-sum proposal for the execution of a definite contract.

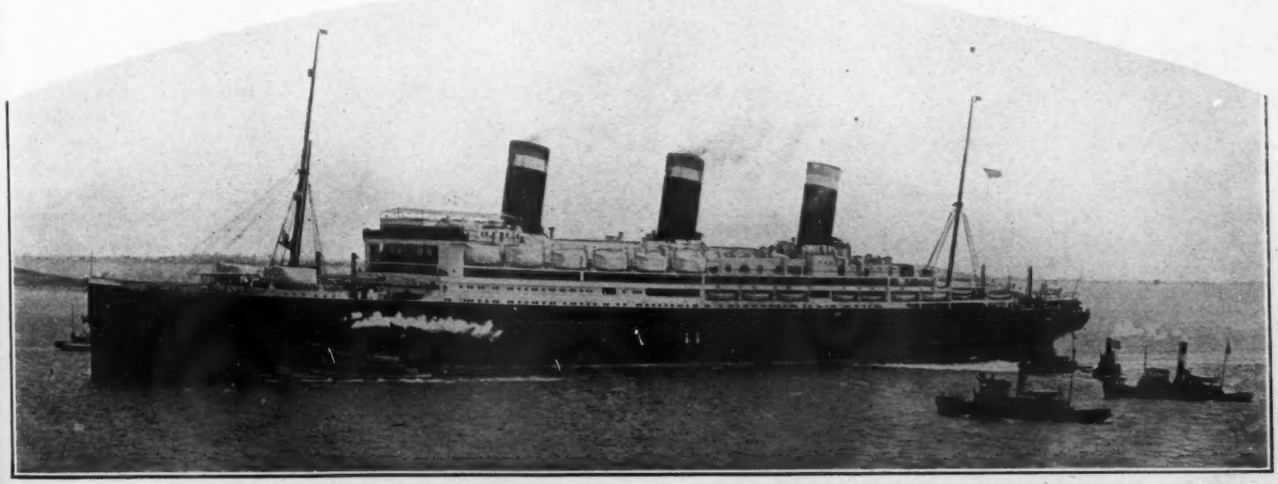


Commissioning the reconditioned "Leviathan." The officers of the ship standing at attention as "Old Glory" was raised.

On February 15, 1922, the Shipping Board awarded the contract for the reconditioning of the *Leviathan* to the Newport News Shipbuilding & Dry Dock Company—the sum involved being $6,110,000, which covered the cost of converting the craft to an oil burner. All told, the rehabilitation of the giant ship has entailed an outlay of $8,190,000. Of this Messrs. Gibbs Brothers received $182,000 for their share of the work. What the nation has paid for this splendid venture is a great deal less than it would have had to spend in creating a new craft of the size and characteristics of the *Leviathan*.

It is impossible within the space available to more than hint at the imposing features of this liner; and we shall limit our description to citing some facts supplied by the Shipping Board. On her trial trip the *Leviathan* made a world record for speed, averaging 27.48 knots for 25 hours and covering in that time 687 nautical miles. From bow to stern she measures 950 feet 7 inches; she has a beam of 100 feet; and she is rated at 59,956 gross tons. When loaded, her mean draft is 39 feet 6 inches; and from the water line to the top of her smokestacks is a distance of 144 feet 6 inches. Her turbines develop a propulsive effort of 100,000 H.P.; and to feed the furnaces of her 46 boilers the steamship carries 9,260 tons of fuel oil. The driving power is delivered by 8 turbines to 4 propeller shafts; and the normal sea speed is 23 knots. The operating personnel numbers 1,138; and passenger accommodations are provided for 3,397 persons. Gaged by standards that are recognized the world over by the shipping fraternity, the *Leviathan* as we know her now is well-nigh a new ship and a much better vessel than she was when she first reached American waters in the spring of 1914.

Captain Herbert Hartley, the *Leviathan's* commander, was born in this country and began his seafaring career aboard the old schoolship *Saratoga* more than twenty years ago. The *Saratoga*, a sailing ship, was then maintained by the State of Pennsylvania. Captain Hartley's education gained aboard the *Saratoga* has proved its worth on many an occasion since; and upon that foundation of nautical knowledge he has built surely the reputation which has won for him his present command.



The "Leviathan" leaving Boston for her 5-day trial trip which proved how thoroughly she had been made fit for transatlantic passenger service.

Cost of Paint Versus Cost of Painting

Use of the Modern Air Brush Cuts the Total Cost of the Work in Half

By HOWARD W. BEACH

Eclipse Air Brush Company, Newark, N. J.

HOW MANY manufacturers realize that the cost of paint represents less than one-third the cost of painting when the paint is applied by hand-brush workers? Records made of a typical case of painting a plant by the hand-brush method reveal that $4,200 was spent for labor to apply paint costing $1,800, or $2 for labor for every dollar paid for paint. This is a fair case. In ordinary factory maintenance, $4, $5, or $6 are not infrequently expended for labor to apply a dollar's worth of paint.

One way to save is to use good paint. The better the paint the longer the interval between painting—hence a lower outlay per year of service. On the other hand, supposing paint to cost nothing at all, the labor charge to brush the paint on by hand would still loom large on the books. Logically, therefore, men responsible for maintenance sought a new and better method of application, inasmuch as application was the item that represented the principal part of the cost of painting. As a result, the air brush is now widely used for factory, mill, and industrial plant painting, both exterior and interior.

What does the air brush accomplish? "A week's work in a day," as demonstrated by actual performances. In other words, a surface that it takes a hand-brush worker a week to cover can be painted in one day by an air-brush operator! A similar but much larger plant than the one referred to in the beginning of the article was painted recently by air brush. The costs were: $4,000 for paint and $1,800 for labor. Compared with the first example, air-brush application here saved over 50 per cent. of the cost of painting. Labor saving, great as it is, however, is not the only advantage of air-brush painting. Speed, cost of scaffolding, accident prevention, ability to reach surfaces inaccessible to the hand brush, are other important features. For instance, it is sometimes just as necessary to make speed as it is to save money. Air-brush application, as has been emphasized, takes but a fraction of the time required to do the same amount of work by hand brush. Recently the exterior of a good-sized plant was both cleaned and painted by air in 100 man-days as against the 500 days estimated for hand-brush work. The low-pressure air brush applies paint at hand-brush consistency without special thinning, hence a dense and elastic coat is obtained. More paint may be put on at one application by air than by hand. On inside work, one coat applied by air can, therefore, be made to equal a two-coat, hand-brushed job, while on outside work two air-brushed coats equal three hand-brushed ones. These factors are important in reckoning both cost and speed of painting.

Obviously, "over-the-week-end" painting is desired in most factories. It is clear from the foregoing that the air brush is an adept Saturday to Monday worker. The entire interior of a good-sized building can be painted in this interval by two operators working one air brush in shifts. A larger plant may be divided into convenient sections. By painting one of these at a time the whole plant may be gone over in a few weeks without a single interruption during manufacturing hours.

Materials, parts, and finished products must not be damaged by spattering paint. Where paint is dipped out of a can by brush, drop cloths must be rigged up for protection. With the air brush the operator's entire attention is given to the application of the paint. He does not have to bend, fill his brush, and swing it over his head. The spray of paint, issuing from a low-pressure air brush, is under his complete control; and all the paint goes on the surface to be covered. Drippings and objectionable fumes are eliminated. Strange as it may seem to those that have done home painting jobs, and that have wondered at the amount of paint that was spattered on clothes and on floors, entire plant interiors have been painted by air brush without drop-cloth protection and without the slightest damage to materials lying directly beneath the painted surfaces.

Scaffolding is another item in the cost of painting. The air brush, because of its wider range, materially reduces the amount of work that must be done from scaffolding and even from ladders. Where ladders or scaffolding are necessary, the air brush diminishes the hazard of falling. The operator has only the "gun" to handle and is not bothered with the open paint pot or the constant dipping of the brush. The physical effort is less with the gun than with a bristle brush, as the operator does not have to wipe out or spread the paint. One large works, in figuring estimates for painting, allowed $10,000 for probable claims arising from scaffold falls, based on past experience with hand-brush workers. The job, however, was done by air brush without a single accident of that kind.

The saving in dollars and cents effected with the air brush has been indicated by the facts presented. But there is still another side to the question. Plants which own an air-brush equipment seem automatically to "spruce up."

The paint-maker's famous slogan, "Save the surface and you save all," is a good one, but it tells only half the story. Preservation is one thing, but, nowadays, owners and manufacturers do not paint for preservation alone. Plants are kept freshly and brightly painted for the effect on the morale of the employees. Paint is used to create better lighting and thus to increase production and to decrease spoilage. Actual production increases of 10 and 12 per cent. are common after a factory interior has been painted with a proper regard to lighting values. White paint reduces electric light bills, in fact, 25 per cent. of the lighting cost has been saved in this way at the Staten Island ferry terminals of New York City.

Paint is also used for its sanitary value. One paint manufacturer has demonstrated that it pays to paint white spots in the corners of floors. Workmen won't spit on white paint. In short, there are a hundred and one important uses for paint in industry. With the air brush the work is handled quickly and cheaply. The cost of the paint is practically the only item of expense to be considered because the maintenance department can usually swing the job of painting so that it can be done on slack days. As a result, painting is made short work of where ordinarily it would be neglected.

An air brush may be bought originally to lessen the difference between the cost of paint and the cost of painting; but, once utilized, the air brush soon becomes a regularly employed maintenance tool that makes any plant a better place to be in physically, mentally, and morally.

Another use of the air brush or paint-spraying machine is in the economical application of metal protective coatings. Asphalt and graphite paints, iron oxides, and 20 and 25-pound red lead can all be applied at hand-brushing consistency and, latterly, it has also been feasible to spread an oil preparation or rustproofing compound in the same manner. The fatigue that is felt by the painter when applying red lead in the old way is eliminated by the air brush, and it also enables the opera-

Engineer's Comparative Cost Figures on Large Work

Cost per 100 sq. ft. ceiling—Air Brush

Labor	$1.05
Material	1.00
Power	.03
Depreciation	.005
	$2.085

Cost per 100 sq. ft. ceiling—Hand Brush

Labor	$2.62
Material	1.10
	$3.72

Painting wall, no scaffold, 100 sq. ft—Air Brush

Labor	$ .30
Material	1.00
Power	.03
Depreciation	.005
	$1.335

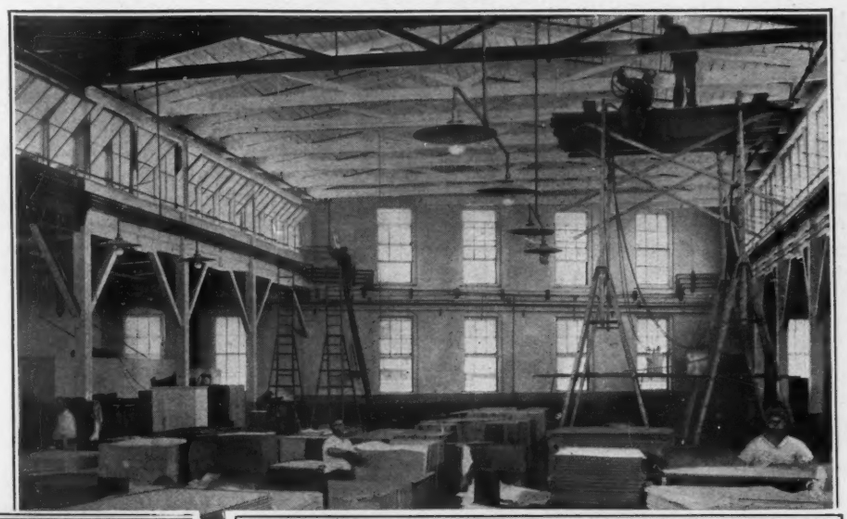
Painting wall, no scaffold, 100 sq. ft.—Hand Brush

Labor	$1.20
Material	1.10
	$2.30

tor to put on a more even coat and to better protect seams, rivet heads, etc., because of the penetrating force given the paint by the air impulse.

The use of compressed air for painting is not confined to heavy, rough work, such as is shown in our illustrations. At the present time, automobiles are being finished at the factory from undercoaters on through to color varnishes; and even the finishing varnish is being applied by air. A great many plants have recently sprung up where automobiles are being refinished in practically the same way. In some of these small refinishing shops, lacquers are being employed; and the owner of an automobile is now no longer deprived of his car for five or six weeks. As a matter of fact, it is possible to entirely refinish a motor car in not exceeding a week's time. The completely hand-brushed product is today an exception.

Spray painting the ceiling and trusses of a loft without having to spread drop cloths to protect floors and goods and without interfering with normal activities.

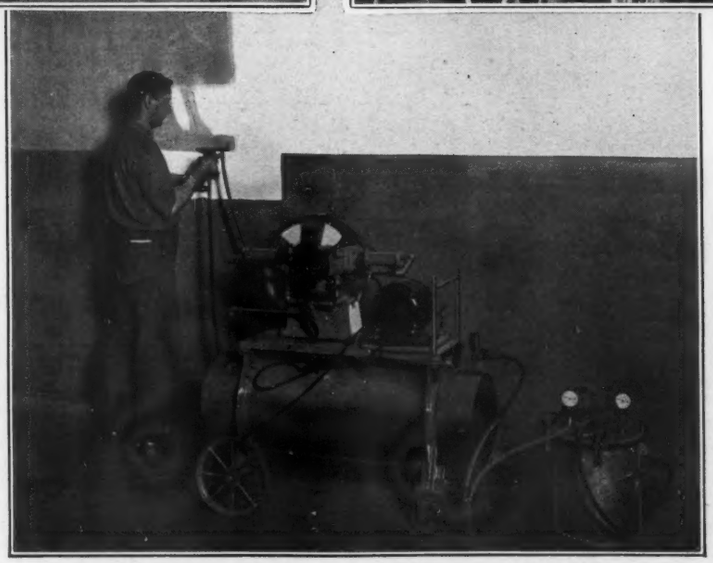


Brightening up the interior of a shop with a coat of mill white applied quickly and efficiently by means of a portable air-brush outfit.

The air brush makes it possible for an operator to easily reach and to properly paint overhead and fairly inaccessible areas.

Furniture of every description, from the cheaper grades on through to the very finest, are finished by the air-brush method. Shellacs and varnishes, stains, enamels, etc., are all applied by means of compressed air; and the results are better than those obtained by the use of the hand brush.

The principle involved in applying paints, enamels, japans, lacquers, etc., by the aid of compressed air is also being utilized to spray silicate of soda, paraffin, waterproofing oils, etc. While the application of materials by compressed air is in its infancy, great strides in the art have been made in the last few years, and the chances for its future development look particularly promising.



A complete spray-painting equipment. The operator uses a protecting shield to preserve the line between the lower dark and the white sections of the concrete wall.

The old-time oil operator did not know very much about scientific methods. From his experiences in drilling wells, however, he learned a lot about oil formations. He evolved a working formula, and this became the foundation of modern oil geology.

When the geologist first appeared in the oil fields, he was liable to be classed with "oil witches" and "oil smellers." He was called a "rock hound," a "wrinkle chaser," or a "pebble pup." Now he is the nucleus of the trained force working for the discovery and the development of oil considered in the light of engineering problems.

PHILIP WEISS PASSES ON

PHILIP WEISS, District Manager of the Philadelphia and Scranton territory of the Ingersoll-Rand Company, died suddenly on August 15 while on a visit to his son at Dayton, Ohio. He was born May 17, 1856, and was, therefore, 67 years of age at the time of his demise. The interment took place from his home, 190 Ege Avenue, Jersey City, N. J., three days later.

Mr. Weiss' whole career exemplified the possibilities of a selfmade man. Of limited education, he rose through his own ability and successful service from an ordinary salesman to a district manager. Thirty-three years before his death he called at the office of the Ingersoll Rock Drill Company at 10 Park Place, New York City, in an effort to sell contractors' supplies—doing business, at the time, on a commission basis and without salary. His straightforward manner, knowledge of the subject, and clear judgment so impressed itself upon the manager of the Ingersoll Company that he was offered a position of salesman on a small salary and commission. By reason of his effective work he gradually advanced in the confidence of his employers until he became a general salesman, working in other states and territories. He was, in fact, one of the builders of the Ingersoll-Rand Company.

In course of time, as business expanded, Mr. Weiss established a district office in Philadelphia—covering several states from that point. Subsequently, as circumstances warranted, he organized other offices at Birmingham, Ala., Knoxville, Tenn., Scranton, Pa., Washington, D. C., and Pottsville, Pa. The territory of the Philadelphia office thus became a very broad one, embracing as it did for some years the entire South. Although Mr. Weiss had many assistants, he invariably held his largest customers through personal contact—calling on them at frequent intervals.

The extensive business which Philip Weiss built up was in the main a recognition of his personality: that is, his customers stuck to him, solicited his advice, and sent for him when machinery was needed or when they were in difficulties. Although not trained as an engineer, he cultivated engineering knowledge to such an extent and so successfully that he was able to install large plants designed to suit the conditions under which the work was to be done. What he did not know about engineering he invariably acquired by consulting the engineering force of his company.

Philip Weiss possessed characteristics which made him distinctive; and through thrift and business ability he accumulated a substantial competence. His judgment was remarkable. His salesmanship was ideal: he was never offensively aggressive, but would sit on a job for weeks—being unfailingly careful not to approach a prospective customer at an inopportune moment. He was uniformly polite; and in all things truthful. He never deceived a customer; and after receiving an order he took as much interest in the success of the plant as he did in getting the order. He made it a point to visit his friends periodically to see if the machinery which he had sold was giving entire satisfaction and to offer his service and advice.

Philip Weiss was a true philosopher; and his attitude towards life won for him the regard of all who knew him. He held the confidence of his subordinates, and he possessed the rare quality of being able to impart to his men something of his own enthusiasm and grasp of the fundamental essentials of successful salesmanship. His personal character was above reproach; and his manner was always gentle. He was a loving husband, and

Philip Weiss

a wise and kindly father. He leaves a legion of friends and acquaintances to mourn his passing. He was a member of the Engineering Society of Northeastern Pennsylvania, of the Engineers' Club and of the Manufacturers' Club of Philadelphia, and was identified with other organizations. He was a Shriner, belonging to Lulu Temple, Philadelphia.

POWER IN A KILOWATT-HOUR

THE following figures, compiled by French officials, are worth reprinting: One kilowatt-hour of electrical energy will drive a sewing machine for 20 hours; clean 15 steel table knives for a year; clip 5 horses or 25 sheep; heat water for shaving for one month; light 3 cigars a day for 5 years; heat a flatiron for 3 hours; boil 2.37 gallons of water; fry 15 chops in 15 minutes; heat a curling iron for 20 mornings; incubate 250 eggs; milk 20 cows; separate 350 gallons of milk; churn 440 pounds of butter; chop half a ton of straw, etc., etc.

Assuming these items to be approximately correct, one-third should be added to each in computing the work of a horse-power-hour.

The Buick Motor Company, in the announcement of its "Quality Motor Cars" for 1924, mentions 4-wheel brakes as one of their novel and desirable features.

THE "TIN HAT" FILLS A PLACE IN INDUSTRY

THE trench helmet, the "old tin hat" that served in some measure to deflect the shrapnel hail on the war-swept fields of France, is coming into extensive use as a head protection against falling rock and ore in the mines of California, West Virginia, Oklahoma, and many other states, according to R. V. Ageton, metal-mining engineer of the Bureau of Mines. The helmets are being worn in shaft sinking, in raising operations, and in and about hoisting shafts; and "trench shoes," or similar heavy boots, are also being utilized as a medium of foot protection.

The Cornish miner of earlier days, who has left his mark in nearly every metal-mining camp of the United States, usually covered his head with a hard, resined-felt hat, on which was stuck a candle—the candle being held in place by a gob of mud. The hat was hot and cumbersome; but long years of mining experience had impressed on the Cornishman the wisdom of thus safeguarding his head from bits of falling rock. His heavy cowhide boots, with soles half an inch to an inch thick, undoubtedly prevented many an injury to his feet.

Stiff hats are still widely used in some mining districts; but, in general, the custom is not nearly as common in mines of this country as it should be. In recent years, however, there has been noted a gratifying increase in the employment of protective headgear by our miners. Many soldiers had been miners; and they came back with a wholesome respect for the trench helmet and the trench shoe. After being discharged, numbers of them returned to the mines, and brought with them the trench hat and the thick trench shoes. As one miner in an Oklahoma zinc mine expressed it, "If 'the old tin hat' would stop shrapnel, I reckon it'll stop these small pieces of 'jack'."

Both the miners and the operators have been quick to recognize the advantages of adapting these war-time devices to mining; and one mining company was so impressed that it bought a large quantity of trench helmets and distributed them among its employees.

VAST IRRIGATION PROJECT IN INDIA

AT THE completion of the most pretentious irrigation project attempted in India, 3,500,000 acres of excellent farm lands in 14,300 square miles of India's Sutlej Valley will be thrown open to settlers. During the past 30 years, large tracts of waste land in the Punjab have been made fertile by irrigation; and for the first time in the history of undertakings of this nature the Indian government has realized its mistake in neglecting to construct roads along with the canals. The authorities are now acquiring the rights to build adequate roadways for the transportation of crops to markets and railways. It is estimated that it will take nine years to finish the whole Sutlej project.

Memphis, Tenn., is the greatest inland cotton market in the United States, handling every year approximately 1,000,000 bales.

Oil Shales and Their Potentialities

The Domestic Status of the Recovery of Petroleum and Valuable By-Products From Our Vast Oil-Shale Deposits

By RICHARD HOADLEY TINGLEY

THE FACT that there exist in this country immense shale-oil deposits from which crude petroleum may be extracted, with its valuable by-products, has long been known to the oil trade, to the United States Department of Mines, and to the public. However, until recently, comparatively little attention has been given the matter because it is so much easier and cheaper to drill wells, and, apparently, to obtain all the oil required. It has thus come about that these deposits have been neglected—their development being in a decidedly experimental stage.

Oil men have finally awakened to the fact that we have been consuming our store of this natural product in a most prodigal manner, just as if there were no limit to the supply, and it has recently been borne in upon them that there is a very definite limit; that millions of barrels of petroleum have been wasted; that productive oil-fields have not been properly cared for; that unscientific drilling and methods of production have caused waste beyond measure in barrels of crude or dollars; and that notably inefficient refining practices have added to the further depletion.

The United States is far and away the largest producer of crude oil—her 470,000,000 barrels in 1921 equaling 62 per cent. of the world's total of 765,000,000 barrels. Mexico is the nearest competitor, with but 193,000,000 barrels; and Russia, the Dutch East Indies, Persia, Rumania, India, Poland, and Peru come along in the order mentioned with lesser quantities. Notwithstanding, ever since 1915 this country has steadily been consuming more oil than it has been producing and has been making up the deficiency with imports almost wholly from Mexico. An accompanying table makes this clear.

The United States Geological Survey estimates that there remain in the ground in this country about 9,150,000,000 barrels of petroleum recoverable by current production methods. This is admittedly little better than a scientific guess; but, guesswork or fact, it has been taken as a warning, for, with an annual consumption of 500,000,000 barrels, it can readily be appreciated that the estimated store will not last twenty years. It may be much less than twenty years if the past increasing rate of usage continues. From 35 gallons per capita per year in 1900, the demand grew until it reached 96 gallons by 1910; 210 gallons by 1920; and 231 gallons by 1921. What of the future? Imports, from where? Mexico, which now yields less than 200,000,000 barrels a year and whose supply is known to be running short? From Mesopotamia? From the Chester concessions in Turkey? The answer is found in none of these possibilities, but, rather, in an economic solution of the problems of mining and of refining the oil shales that so abundantly exist in many of our western states.

Convinced of the seriousness of the situation, the United States Bureau of Mines caused a most critical and analytical examination of the oil-shale question to be made last year by Mr. Martin J. Garvin, whose findings have been published in Bulletin 210. Spurred on by this report; by private investigations that had been made; and by the fact that unscrupulous promoters were exploiting oil-shale lands in the usual disastrous manner, the American Mining Congress brought together at a general conference last October the members of its oil division, and placed the seal of endorsement upon shales as the country's oil hope of the future.

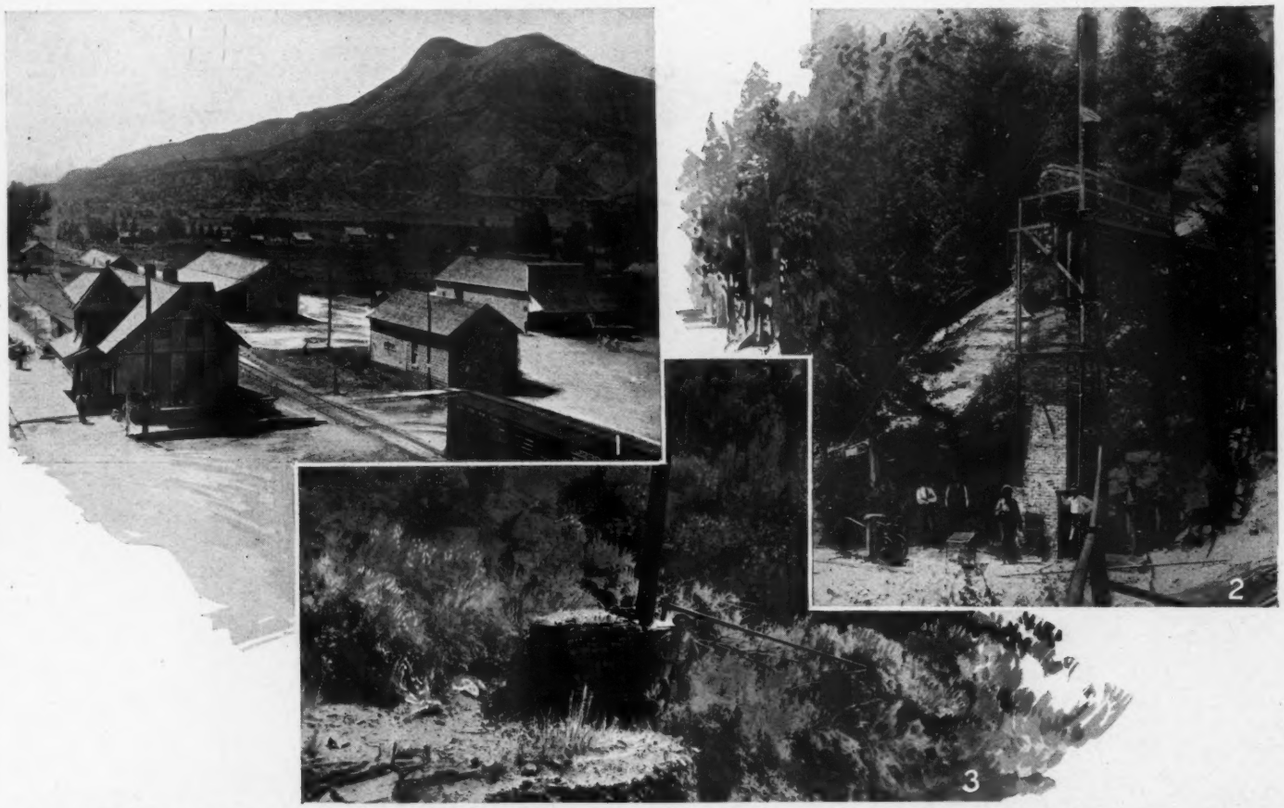


Fig. 1—Grand Valley on the Denver & Rio Grande Railway with a mountain of oil shale in the background. Think of the millions of barrels of fuel that may be reclaimed from this storehouse. Fig. 2—An experimental plant, erected by the U. S. Geological Survey, and used by that governmental bureau to determine the practicability of distilling oil from western shales on a commercial scale. Fig. 3—The shale-oil industry in America dates back a number of decades. Here is a modest plant built by the Mormons in Utah more than half a century ago.

PRODUCTION, CONSUMPTION, AND IMPORTS OF PETROLEUM IN MILLIONS OF BARRELS.*

Year	Domestic production	Domestic consumption	Yearly excess consumption over production	Imports
1914	266	261	—5	17
1915	281	273	—8	18
1916	301	319	+18	21
1917	335	378	+43	30
1918	356	413	+57	38
1919	378	418	+40	53
1920	443	531	+88	106
1921	470	526	+56	125
1922	551	586	+35	135

*From U. S. Bureau of Mines.

That body recognized that a still greater demand for oil was sure to come about with the growing popularity of the automobile, which now consumes between 80 and 85 per cent. of all the gasoline produced. There are in this country today nearly 12,000,000 cars and trucks; and it is predicted that twice that number will be registered within the next ten years. It also believed that, whether these estimates are reliable or not, it was time to bestir itself and to devise some economic processes for mining and for refining shale oil. As one member put it, he hoped, at the next meeting, to be able to tell how he had done the trick rather than how he thought it ought to be done.

Garvin defines oil shale as "a compact, laminated rock of sedimentary origin, yielding over 33 per cent. of ash and containing organic matter that yields oil when distilled, but not appreciably when extracted with the ordinary solvents for petroleum." Oil shales are found in many parts of the world, but the deposits of Scotland, because they have been the basis of a profitable commercial industry for many years, are the most widely known. In a small way, oil-shale beds at Dorset, England, have been operated for centuries, while those that are known to exist in both Wales and Ireland have not been successfully worked for practical reasons.

A more or less satisfactory production of oil from shales has been going on in France, Australia, Esthonia, and Brazil. In Canada, New Zealand, South Africa, Jugo-Slavia, Spain, Sweden, Bulgaria, Germany, Italy, and Switzerland there are oil-shale deposits, almost all of which have been investigated as to the feasibility of operating them. Commercially, however, little progress has been made, though nearly all the countries concerned are aware of the eventuality of an oil shortage and recognize the potentialities of shale oils. Concessions are being granted and plans formulated for the commercial development of these far-flung beds.

Nobody has yet been rash enough to hazard an estimate of the total quantity of oil obtainable from the immense shale deposits in this country, or how far this supply may be expected to supplement the diminishing oil from our wells. Such figures are yet to come. Colorado leads in the matter of possible oil from shales. Mr. Victor C. Anderson, President of the Colorado School of Mines, has brought this fact out in the following table of oil-shale acreages in six states, where the largest deposits have been explored. Inasmuch as Colorado averages the biggest yield per acre, he has taken this as 100 per cent., and has compared the average acre yield of the other states therewith. In his table, richness and thickness only are considered.

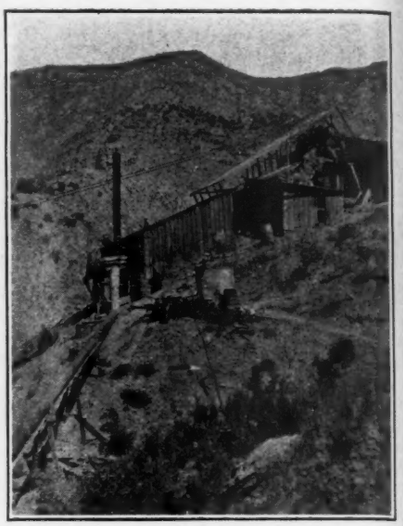
Hand drilling to secure unweathered samples of oil shale. The weathered shale does not afford a true index of the oil content of the rock.

A vertical retort battery. The plant is in operation in Utah.

APPROXIMATE RELATIVE VALUE OF OIL SHALES

State	Relation per cent.	Acres
Colorado	100	900,000
Kentucky	27	609,686
Utah	20	2,700,000
Indiana	20	320,000
Wyoming	9	500,000
Nevada	8	1,000

In reporting on tests of oil shales made by the Colorado School of Mines at many places in Grand Valley, Col., Mr. Roderick T. Burnham shows the following results:



Here we have an example of an inclined retort plant which is dealing with oil shales in Colorado.

BARRELS OF OIL PER ACRE

Test	Thickness of vein in feet	Barrels of oil per acre
1	8.5	25,750
2	23.5	53,400
3	6.0	5,500
4	9.0	8,850
5	10.5	10,500
6	11.5	10,350

The average yield amounted to about 40 gallons of oil per ton of shale.

Mr. J. B. Jensen, of Salt Lake City, gives the results of four tests of Utah shales as follows:

Location	Acres	Thickness of strata in feet	Total yield barrels
Soldier Summit	50,000	20	2,178,000,000
Uintah Basin..	125,000	30 to 60	10,890,000,000
Watson and White Rivers	50,000	30 to 50	3,267,000,000
Naval Reserve	92,160	40	8,016,040,000
Total	317,160		24,351,040,000

The average yield here amounts to about 42 gallons (one barrel) of oil per ton of shale—the American average being somewhat below that figure. In Esthonia, shales running 77 gallons per ton have been found, while in Australia, shales as rich as 180 gallons with a minimum of 80 to the ton have been mined and distilled.

In Colorado, 26,000 acres of oil-shale lands have been patented. Several retorts have been erected there, and mining and refining processes are in operation, though not, as yet, on a commercial scale.

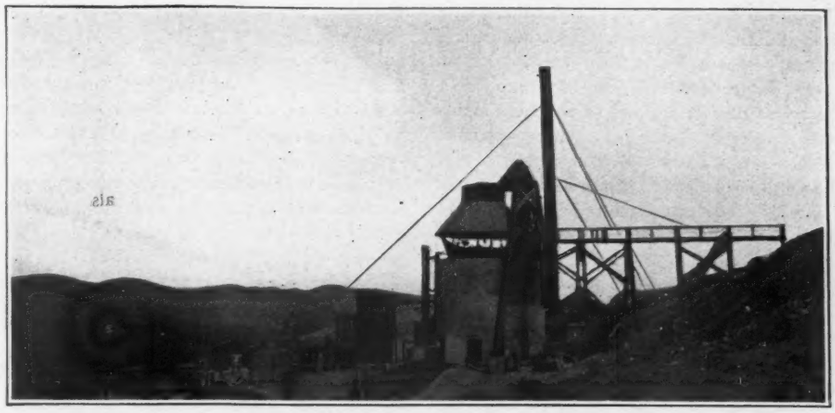
Last October, after six years of experimental study, the Elko Oil-Shale Products Company, near Elko, Nev., was mining and refining shale at the rate of 144 tons a day—at a small margin of profit, so it is said, though Mr. R. M. Catlin, the owner, admitted that his work was too new to tell how profitable or unprofitable it might prove. It is declared that this plant represents the nearest approach, in this country, to anything like commercial production.

Oil shales have been exploited in Indiana, Ohio, Kentucky, California, and Montana. In none of these states, however, has the operation of mining or retorting been started in what

might be called a business way. Activity, however, is looked for in them all in the near future, for oildom is thoroughly aroused to the need. In Kentucky there are at least two large companies that have signified their intention of beginning operations; and the same may be said of California. Oil shale deposits are known to exist, in addition, in New York, Pennsylvania, West Virginia, Tennessee, Missouri, Kansas, Oklahoma, and Texas; but little information is available about their extent or their value.

The production of oil from shales is, first of all, a mining operation. The shales must then be crushed and retorted, and, in solving these problems, America offers little precedent. They must be worked out independently and economically before the industry can be firmly established. Engineers, however, are all looking to Scotland for their guide; but, in doing so, much caution must be observed because of the difference in circumstances, and of the character of the shale and its component properties.

In the matter of mining, no great obstacles or difficulties are expected to arise that have not been met and solved in other mining operations. Except in rare instances, steam-shovel or open-cut methods will not be practicable. Almost all the deposits carry a prohibitive overburden, and shaft and tunnel work must be resorted to. As a rule, the shale strata lie in a horizontal position, or nearly so, and the opinion is that a shale mine, going full blast, will be operated much as our coal mines now are. The "longwall" and "room-and-pillar" systems are most favored, but, where the veins are thick, the "carving" method may be employed. The performance of all this work points to an extensive use of compressed air.



This vertical retort battery, in Nevada, is said to be the largest oil-shale retorting plant in the United States.

The primary and the secondary products to be derived from the distillation of shale oils will be: crude shale oil, hydrocarbon gas, ammonia, spent shale, gasoline, kerosene, lubricating oil, paraffin, dye compounds, explosives, rubber substitutes, paints, alcohols, asphalts, naphtha, gas and fuel oils, wax, and carbon black. In some localities ichthyol may be added to the list. In Scotland, much attention has been paid to the recovery and treatment of paraffin wax. The multiplicity of these products suggests a field of useful and profitable activity to the prospective oil-shale miner and refiner when the time is ripe for him to supplement the production of the oil-well man or to enter into competition with him.

An outcropping of oil shale in Colorado where very rich oil-bearing rock exists.

In the neighborhood of 75 processes have been advocated for the treatment of oil shale or tried during the past few years, and it is clear that a universally acceptable American design has not yet been developed. Small plants, mostly experimental and for purposes of demonstration, have been erected in various parts of the country: two or three in Hoboken, N. J.; one or more in Illinois and also in Kentucky; one in Kansas City; half a dozen are divided between Denver and Salt Lake City; and there are at least two in both Nevada and California. All the plants are much alike in appearance, and one of the photographs shown is typical of them. None has operated on what may be called a practical scale—in fact is not large enough to be considered a commercial installation. Tests seem to indicate that the Scotch retort design will not be suitable for our shales—frequent attempts to duplicate the equipment and the process having resulted in failure.

Practically every large oil company in the world has already secured extensive holdings of American oil-shale deposits and is or has been conducting scientific field and laboratory research in what is recognized as a coming industry. This is evidence that big oil producers foresee the potentialities of the business, and that they realize it is well to throw an anchor to windward.

Although it is true that a great variety of by-products may be obtained from shale oil, yet many of these are already supplied in sufficient quantity by chemical concerns. It has been pointed out, however, that, in the economical recovery of the main derivatives—fuel oil and gasoline—good profits are to be made in the manufacture of some of these by-products. One of these is carbon black—an industry that is in a more or less unsettled condition.

Carbon black is a product resulting from the incomplete combustion of gas, and is deposited, by actual contact with a gas flame, upon a metallic surface. Most of it is derived from natural gas; and it has been pointed out that the process is an uneconomical use of this valuable fuel. The trade, it seems, would welcome the advent of a new source of supply so as to relieve it of the necessity of meeting the demand at the expense of so much natural gas.

The output of carbon black, according to the Bureau of Mines, amounts to 43,500,000 pounds a year, of which about 30,000,000 pounds comes from the natural gas of West Virginia; 8,000,000 pounds from Louisiana; Wyoming supplies 3,000,000 pounds; Oklahoma 1,500,000 pounds; and other states about 1,000,000 pounds. From 10,000,000 to 12,000,000 pounds annually goes into printer's ink; 20,000,000 pounds into rubber compounds; 4,000,000 to 5,000,000 pounds into stove polish; and about 1,000,000 pounds is utilized in the making of phonographic records, carbon paper, tarpaulin, black leather, bookbinder's board, stenciling ink, artificial stone, black tile, and India ink. The call for these commodities is stable—rubber compounds using by far the largest quantity. Prior to 1912, carbon black cost about 5 cents a pound. Since that time the price has steadily advanced, owing to the uncertainty of the supply, to 15 or 20 cents for the lowest grade and to 50 cents for the best quality.

Several companies in the Grand Valley and DeBeque districts of Colorado are experimenting with carbon-black production pending the full development of the shales for fuel oil. As they see it, carbon black offers an excellent opportunity to cover themselves, so to speak, while waiting—or, rather, while working. Some are optimistic enough to think that the recovery of the by-products, such as carbon black, ammonium sulphate, paraffin wax, and others already named, can be made the basic purpose of the shale-oil industry, in the upbuilding of which they might thus escape the antagonism of the larger oil interests. This view has been strengthened latterly by the discovery of an economic flotation process for the recovery of carbon black. After the oil has been produced by retorting, the residue yields the carbon black—the oil itself being used as the flotation medium.

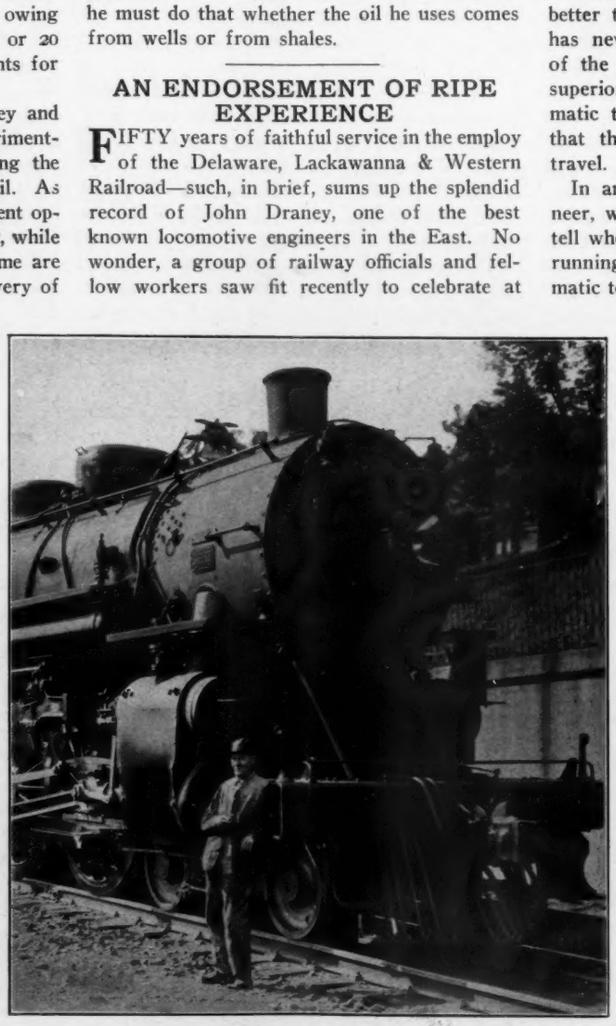
There are those that aver that an oil-shale enterprise based on the manufacture of carbon black and crude shale oil would occupy an enviable position. Major G. R. DeBeque recommends a plant equipped with a simple oil-condensing unit as well as a gas-burning unit which, he says, would be able to turn out either oil or carbon black, or both—the choice depending on the market.

It is claimed, and with reason, that crude oil and its refined products can not be reclaimed from shales at the present prices of those commodities. At the moment, there is a large overproduction of oil due chiefly to the pronounced activity of small properties in California, which are sending their yields to the Atlantic seaboard via the Panama Canal. This has resulted in an increase of crude-petroleum stocks in this country from 128,000,000 barrels in 1919 to 278,000,000 barrels at the end of last year. Of late, however, California's production has fallen off somewhat and a reduction in stocks may be looked for. Increased or lessened stocks cut but little figure in the last analysis, which clearly indicates an eventual shortage of oil.

It seems evident, that as long as the oil-well companies continue to produce oil in large volume, as they are doing now, the price will not materially advance. It also seems evident, that at anything like the prevailing prices shale oils cannot compete with well oils for the reason that the shales must first be mined and then crushed before they can be refined—items of expense that raise an almost insurmountable barrier unless, as is confidently expected by shale-oil land owners, the by-products can be made to fill the gap and to overcome the handicap. On the face of it, however, it appears certain that the motorman of the next generation must be prepared to pay much more for his "juice" than now, and he must do that whether the oil he uses comes from wells or from shales.

AN ENDORSEMENT OF RIPE EXPERIENCE

FIFTY years of faithful service in the employ of the Delaware, Lackawanna & Western Railroad—such, in brief, sums up the splendid record of John Draney, one of the best known locomotive engineers in the East. No wonder, a group of railway officials and fellow workers saw fit recently to celebrate at Scranton the golden anniversary of his railroad career which he began as a water boy back in 1873.



John Draney and the locomotive of the Lackawanna Limited.

For years, John Draney has been at the throttle of the Lackawanna Limited; and among other conspicuous acts he points with pardonable pride to the fact that it was his duty to run one of the fast special trains by which doctors and nurses were hastened from New York to Buffalo when President McKinley was stricken by an assassin's bullet. In the course of half a century, Draney has been in a position which has enabled him to observe at close range many momentous developments in rail transportation. He has seen trains grow longer and heavier and, withal, travel faster; and he has been peculiarly fitted in consequence to appreciate the added responsibilities placed upon the man at the throttle.

From his station in the cab of his speeding locomotive, Draney has learned to appraise the character of the roadbed over which he was expected to hasten and to estimate with keen understanding the riding qualities of the track when laid in different ways and by different facilities. Because of this he has long been a booster of pneumatic tools as an aid to the better tamping of ballast under the ties. He has never hesitated to express his approval of the uniform quality of the work and the superiority of the roadbed produced by pneumatic tie tampers. He is firm in his belief that these tools make for easier and safer travel.

In answer to the question: "Can an engineer, when his train is moving at high speed, tell whether or not the track over which he is running has been tamped by hand or by pneumatic tools?" Draney promptly said: "Surely! A pneumatically tamped track is firmer and does not seem to spring under the engine. To my mind, a track so tamped lessens the danger of a broken rail. I have also noticed the same improvement in going over a grade crossing tamped in the new way by air-driven tools. The great power and weight of express locomotives and the speed at which they are run are calculated to show up any flaws or inequalities in the track."

It is very difficult for us to understand the status of anthracite in Great Britain. It seems to be considered an inferior and undesirable fuel, to be thought of only in the light of a substitute, and now a new objection appears to have been discovered.

We learn from the *Daily Mail*, London, that determined efforts are being made by the inspectors of explosives to discover the cause of the "many explosions which have recently occurred in anthracite stoves." It will do no good to seek information over here, for we would not know how to produce an explosion in a stove burning anthracite, and have never heard of one.

Supplementing our article *The Diamond Industry*, which appeared in the April issue of the Magazine, we are advised by the Vianney Wire Die Works that the annual output of diamond dies, used for drawing all kinds of wire, such as brass, copper, gold, steel, resistance, tungsten, etc., calls for something like 45,000 stones ranging from one-sixth carat to twelve carats. The value of these diamond dies amounts to more than $1,000,000 a year.

Wrecking Brick Buildings by Pneumatic Tools

By D. A. SLATTERY

IN THIS DAY of rapid progress, when upbuilding and demolition seem to go hand in hand, the man in the house-wrecking business is no longer content to go about his work in the slow, old-fashioned way. At least, a Milwaukee wrecking contractor, Mr. George J. Whittaker, has recently proved conclusively that it is not only cheaper to utilize compressed air tools instead of hand labor in tearing down a brick structure but that it is practicable with them to do the job in much less time.

The air equipment used by this resourceful wrecker for the purpose included a 5x5-inch, Type 20, Ingersoll-Rand portable gasoline compressor, mounted on a standard Ford truck chassis, and two MP-1 coal picks or core breakers, which tools were found to give the best results. With this outfit, manned by two operators and two helpers, it was possible to so speed up demolition that nearly three and a half times the amount of work could be done in this way in a given interval as could be accomplished by hand labor. Let us make this plain by giving some comparative figures.

On the job in question, two men with air tools, assisted by two helpers, removed 7,500 bricks from a straight inside wall in one and a half hours, or 1,250 bricks per man per hour. One man and a helper, under the same conditions, succeeded in taking down 1,800 bricks in 22 minutes, or at the rate of 2,454 bricks per man per hour. On piers, between window frames, the pneumatic tools made it feasible for one man and a helper to remove 504 bricks in 12 minutes, or 1,260 bricks per man per hour.

AIR VERSUS HAND TOOLS

Hand labor, 360 bricks per man per hour		$1.87
Air-tool labor, 1,250 bricks per man per hour:		
Interest, depreciation, and repairs per 1,000 bricks at 25 per cent. per annum	$0.17	
Gasoline and oil per 1,000 bricks	.10	
Labor per 1,000 bricks	.54	
		.81
Saving per 1,000 bricks removed by pneumatic tools		$1.06

On the other hand, in order to demonstrate the efficiency of the newer method of wrecking buildings, five men using hand picks were put to work on an inside wall and, in a 5-hour period, these operatives were able to take down but 9,000 bricks, or 360 bricks per man per hour. At this rate, which is above the average for hand labor, they were able to do but 25 per cent. of the work that the men armed with air tools could perform. Another advantage to be accredited to the use of these labor-saving devices is a 20 per cent. increase in the number of whole bricks salvaged from the old walls.

The men on the job, whether they wielded the old-fashioned pick or used the modern pneumatic core breaker, were paid at the same rate, as follows: air-tool runner and hand-pick labor, 75 cents per hour; helpers, 60 cents per hour. The gasoline consumption did not exceed two gallons per hour and, at the present price for the fuel, amounted to about 17 per cent. of the labor cost. The table accompanying this article shows at a glance just what economies have been effected by substituting pneumatic tools for hand tools in the work of wrecking brick buildings.

The 5x5-inch Type 20, Ingersoll-Rand portable, gasoline air compressor mounted on a standard Ford truck chassis.

Pneumatic coal picks making short work of the brick panels between window frames in demolishing a building.

Model MP-1 coal pick employed effectively in wrecking a brick wall.

UNIQUE GO-DEVIL

SOMETHING unique in go devils was tried out not long ago for the purpose of opening a passageway in a clogged sewer. A small alligator was made fast to a wire and lowered down the manhole. Proceeding to the next manhole, the little creature dragged after him the wire to which knotted chains were afterwards attached. It was a simple matter then to work the chain back and forth and thus to remove the obstruction.

A PROGRESSIVE COUNTRY

PERHAPS the most up-to-date country in the world—and you wouldn't think it—is Afghanistan. With almost the same area as Texas—but more up hill and one and a half times the population, it has no railroad and public transportation seems to be entirely by automobile. A contract has been let to an Italian firm for a weekly motor service between Peshawar, in northern India, and Kabul, the capital of Afghanistan.

AROUND AND AROUND

THE earth rotates upon its axis and revolves around the sun. The moon revolves around the earth, but does not rotate. A pulley rotates upon its shaft but does not revolve. A crankshaft rotates but does not revolve. Its crankpin revolves but, like the moon, does not rotate. If the crankshaft have roller bearings the rollers will rotate while they revolve. This item will not rotate but it may go around and around.

TRACTOR VERSUS HORSES FOR TOWING

THE SUBSTITUTION of an American tractor for horses for towing, has proved successful at Colwick, near Nottingham, England. A tractor, weighing a little over a ton, was employed for hauling a loaded gravel barge of 80 tons a distance of about three miles. The trip was completed in 55 minutes.

This method of towing a barge, which is unique in the United Kingdom, was adopted by the Trent Concrete Company. By the change, it is now possible to double the amount of work formerly done, that is, the tractor is able to make five round trips a day as against the two and a half trips made by three horses attached to one barge.

LIQUID AIR USED TO MAKE COLD TESTS OF ZINC

IN INVESTIGATING the properties of zinc roofing, cold tests were recently made by the United States Bureau of Standards on zinc nails and rivets. These were driven at room temperature, then cooled to a low temperature by liquid air, and warmed up again to room temperature without producing any appreciable change. Driving the nails at temperatures from 32°F. to -40°F. developed a brittleness in most of the nails, the heads flying off of those without fillets. In the case of nails with fillets, the heads did not break off. At -31 to -40°F. some of the zinc sheeting became brittle and cracked when pounded. Efforts are being made to determine what types of zinc, if any, will endure such tests.

COPPER USED AS A ROPE PRESERVATIVE

ANOTHER of the many and constantly increasing uses of copper is for prolonging the life and, therefore, the service of rope and cordage. A newly discovered method of treating rope with a solution of copper is proving effective for protection against mold, rotting, and especially the depredations of marine animal life.

Impregnating the rope with tar does little good, as the pests eat the tar out for a first course and then proceed to devour the fiber, itself. The 20,000 fishermen in this country, who are said to use annually 200,000,000 pounds of rope, are substantially benefitted by the discovery.

The International Mining Exhibition held at Agricultural Hall, London, England, a short while ago brought to a focus the results of engineering and manufacturing concerns the world over. As "The Mining Journal" remarked afterwards: "In every field of mining activity today there is an increased demand for equipment that will give the greatest possible reduction in production costs. Messrs. Ingersoll-Rand Company, Ltd., have made great strides in this direction, and their efforts can be appreciated by inspecting their stand at the Mining Exhibition." The accompanying photograph shows to those who were not able to visit Agricultural Hall just what this great concern has to offer in the way of a wide range of tools and apparatus especially fitted to meet the needs of the mining world. These include the latest types of portable compressors, "Leyner" sharpeners, "Leyner" oil furnaces, a complete range of "Jackhamers," drills, pneumatic tools, "Little Tugger" hoists, Cameron pumps, and cement guns.

A GREAT MODERN BELL

WHEN the World War was raging in unchecked ruthlessness, the great bell in the Cathedral of Cologne was melted down into munitions of war. This bell was a memorial of the Franco-Prussian War of 1870—having been cast from captured French cannon and weighing nearly 30 tons.

What is believed to be the largest serviceable bell in the world has been poured to replace it. It is close on to 11 feet high and 11 feet in diameter, and weighs more than 27 tons. Its composition is 78 parts copper and 22 of tin. Antique and religious figures and inscriptions decorate the upper portion of this big bell, which has been baptized St. Peter.

CARBONIC ACID TO THE GOOD

IN A report for the Research Department of the National Jewish Hospital for Consumptives, New York City, Dr. H. J. Corper says that he has proved experimentally that carbon dioxide has an inhibitory effect on the growth of tuberculosis bacilli. Hope is held out that the progress of the dreaded disease may be arrested by supplementing the normal supply of this gas created by functional combustion in the human body. Dr. Meyer, chairman of the research board, admits that, while it would be premature to say just what may be expected from the experiments with carbonic acid gas, "we know an important contribution has been made to our knowledge of tuberculosis."

SAFER ILLUMINATING GAS

AN English engineer, after some years of research, has produced a gas for domestic use containing a negligible quantity of carbon monoxide—thus making it useless for the purposes of would-be suicides and preventing harm through accidental leakage.

When experimentally substituted for the ordinary household gas, through the local gas mains, it was found that no ill effects were experienced by persons who inhaled it intentionally or otherwise, while its heating and lighting properties were unimpaired. The inventor declares that his gas is less costly; and its general adoption in Great Britain may be expected.

Raising Wholly Submerged Ships by Compressed Air

Recent Performance of a New System of Vertical Pontoons Opens Up Great Possibilities in the Field of Maritime Salvage

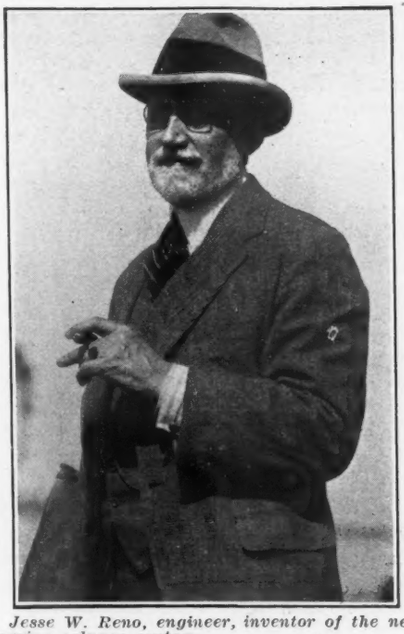
By ROBERT G. SKERRETT

MARINE salvors for many years have hoped that the inventive mind would evolve some commercially effective means by which wholly submerged ships could be lifted from the water bed and towed into a convenient haven where wreckers could do their concluding work unhampered. From time to time, schemes have been devised to achieve this end, but with precious few exceptions the apparatus have fallen far short of practical requirements.

It is a matter of record that a small steamer, the *Sarah Brough*, went to the bottom near Holyhead off the Welsh coast about twenty years ago—sinking in water 75 feet deep, and that that boat was subsequently brought to the surface. She was lifted by four wire hawsers which were passed under her and attached to two pontoons. The lines were tautened at low tide, and the flood tide raised her from the bottom. Thus, by successive stages, she was moved inshore a distance of five miles where she was beached, patched up, pumped out, and towed to Liverpool for repair. The *Sarah Brough*, submerged, represented a total dead weight of only 370 tons.

A modification of that procedure was employed by the Admiralty Salvage Section of the British Navy, during 1919, to recover a vessel from a depth of 138 feet—her dead weight under water amounting to 3,800 tons. Successful as that exploit was from an engineering viewpoint, still the facilities utilized and the expense incurred were such that the accomplishment had little if any commercial significance. Underwriters or ship owners could not afford to embark in so costly a venture. It was plain to the maritime world that inventive cunning must produce some other solution of the problem involved in the raising of heavy and entirely submerged craft.

"Why," the average person will ask, "is it so difficult to deal with a wholly immersed ship?" And this is a reasonable query in view of the fact that marine salvors have saved hundreds of vessels which, to the casual observer, seemed to call for a vast deal of skill, courage, and hard work in order to refloat them. More often than otherwise, the craft that lies below the surface of the water goes to the bottom at an exposed point off a storm-swept coast where even in moderate weather the seas are boisterous. The waves inevitably cause the boats of the salvage flotilla to roll and pitch, and the same motion is imparted to surface pontoons which are, at times, employed to get the wreck up from the sea bed. Therefore, cables binding the pontoons to the sunken ship are subjected to sudden and intense stresses, and these may be sufficient at a critical stage to snap the wire hawsers or to break or rupture some other essential elements of the equipment. But this is not the end of the difficulties with which the salvors have to contend.



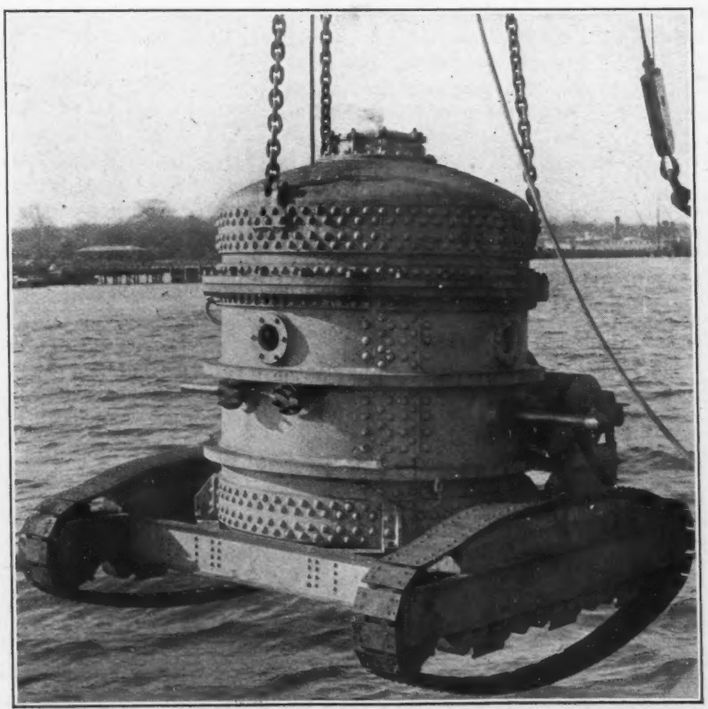
Jesse W. Reno, engineer, inventor of the new marine salvage system.

Not only must the steel cables, the pontoons, and the associate connections be strong enough to withstand the tax laid on them when the sea is rough, but the cables must be so disposed about the wreck that the tugging hawsers will not damage her. To be effective, the wire cables must be capable of withstanding intermittent stresses of 100 tons and more on each of them, and they must be distributed about the vessel so that they will take their individual share of the burden without concentrating the load to a dangerous degree at any point—otherwise, the hawsers might deform the ship's structure by breaking her backbone or tearing right through her hull plating. Injuries of this nature would, in all likelihood, render futile any further efforts to recover a craft in a condition which would make her subsequent repair worth while.

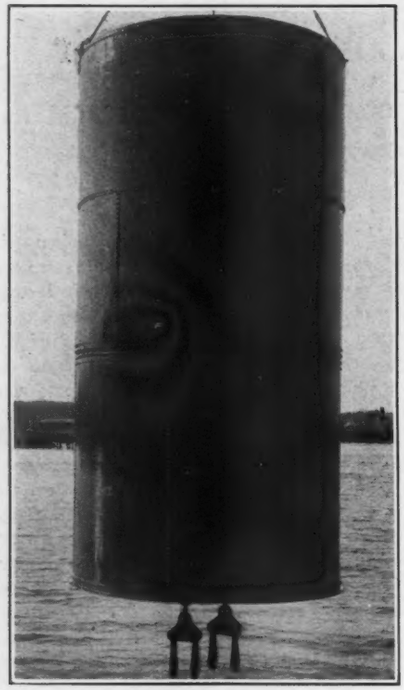
We have purposely detailed the conditions surrounding the lifting of a vessel that has gone to the bottom in the open sea so that the reader may be the better able to evaluate the long step forward in the art which has been made by Jesse W. Reno, an engineer, who has devoted most of his life to mining problems.

Mr. Reno considers marine salvage virtually a form of mining, inasmuch as the object is to extract riches from the sea instead of obtaining mineral values from the earth's crust. Be this as it may, the fact remains that he has devised a system, with suitable apparatus, which he has applied successfully in bringing to the surface a steel boat of 500 tons displacement lying at the bottom of Long Island Sound in 60 feet of water. The manner in which this exploit was performed is ample evidence that the same or kindred facilities could be utilized to refloat sunken steel ships of large size.

Broadly stated, the Reno system obtains its needful buoyant force from a group or series of submergible, vertical pontoons which can be arranged symmetrically on two



The 18-ton electrically propelled, submergible tractor used to drill holes in a sunken ship's steel hull for the purpose of attaching the lifting pontoons.



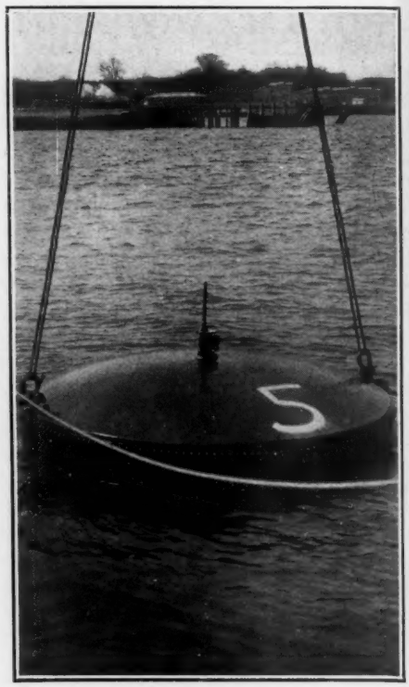
One of the vertical pontoons with its four pendant heavy hooks by which it can be attached to the hull of a sunken vessel.

sides of a sunken craft and secured thereto by hooks firmly lodged in holes bored for the purpose in the wreck's hull plating. The pontoons, when thus tied to the hull, are made to exert their maximum buoyancy through the agency of compressed air which expels from them the contained water. An essential part of the system is a submarine tractor, which settles upon the water bed and moves to any point on either side of the ship where it can drill the holes for the attachment of the lifting hooks and also force the latter into them when the associate pontoon has been pulled under water to effect this.

A novel feature of the Reno pontoon is its unsealed or open lower end. In other words, when floating vertically in the water, the water is free to enter it until only the uppermost part of the pontoon projects above the surface. That is to say, there exists an air pocket inside the upper end of the pontoon, and this space is of sufficient volume to insure a constant reserve of buoyancy amounting to two tons. It is against this buoyant moment that a pontoon is forcibly pulled beneath the water when attaching it by the lifting hooks to a sunken wreck. Therefore, should the hooks become disengaged, or the pontoon be otherwise released, the big cylinder will rise to the surface.

The purpose of constructing the pontoon in this way may not be appreciated by anyone unfamiliar with the physical conditions under which a salvage unit of this sort is expected to work. To make this clear, let us assume that the wreck to be refloated lies in water 65 feet deep and that the lower ends of the pontoons are 50 feet below the waves—representing a hydrostatic head of about 22 pounds. To completely expel the water from the pontoon would, therefore, require an air pressure slightly in excess of this—the steel shell of the pontoon resting nearly neutral between these opposing forces. Now, what would happen if the buoyancy of the air-filled pontoon were sufficient to bring it and its load quickly to the surface? Why, on ascending, with the rapid reduction of the hydrostatic pressure of the outlying water, the compressed air would tend to expand, exerting an uneven and perhaps explosive force against the shell of the pontoon unless means were provided for its speedy escape. The sealed-cylinder type of submergible pontoons is usually fitted with automatic relief valves. These valves, if large enough and promptly responsive, answer the purpose, but if they fail to function then there is apt to be trouble, and the pontoon may burst and sink.

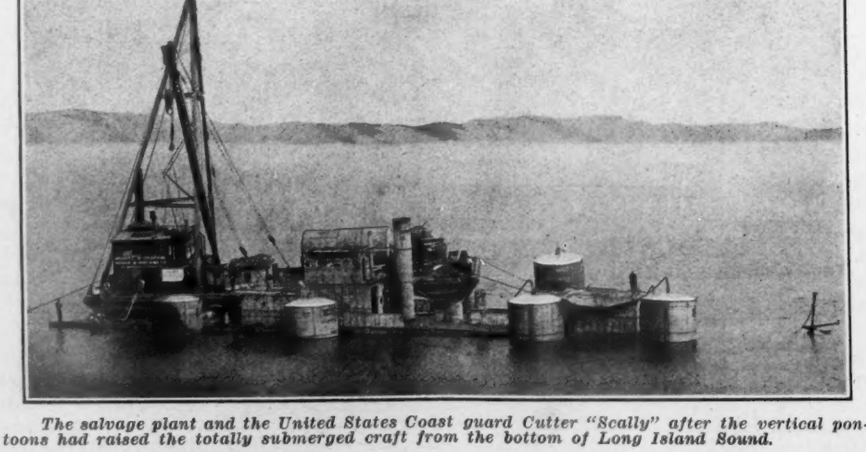
The Reno pontoon, with its lower end open, furnishes an easy avenue of escape for the expanding air during the journey surfaceward, and this compensation continues automatically while still assuring the retention of a plenty of air to provide the maximum-designed buoyancy at every stage of the ascent. Just how much force the expanding air can exert was demonstrated in a spectacular manner during one of the preliminary operations in connection with the refloating of the Coast Guard Cutter *Scally* near Whitestone Landing, New York. Each of the pontoons used in raising that erstwhile Eagle boat had a diameter of 12 feet, a length of 25 feet, and a buoyancy of 70 tons when filled with air. At the time in question, the wreck had a sharp list, and the hooks therefore did not pull parallel with the hull plating but outward and upward at a sharp angle. When the pontoons were charged with compressed air—incidentally expelling the water which had previously almost filled them—the hooks tore through the *Scally's* steel skin, and one of the pontoons thus liberated shot suddenly upward to a height of 25 feet above the water. A few seconds later two more of them skyrocketed in the same manner. The shell plating of the *Scally* is only 3/16 inch thick, while her submerged dead weight was approximately 300 tons. No wonder the fragile structure could not stand the strain.



A pontoon in process of submerging. It is being pulled down by the tractor which is already on the water bed—the pontoon retaining a reserve of buoyancy amounting to two tons.

Subsequently, the experts of the Reno Marine Salvage Corporation, by means of slings suitably attached to some of the pontoons and to the *Scally*, were able to right the boat. Then, with eight of the pontoons in proper position and hooked into holes bored by the tractor, the sunken cutter was brought to the surface as shown by one of the illustrations accompanying this article. As will be seen in that picture, each pontoon has its own air connection leading from the floating derrick, on which was installed a compressor having a capacity of 340 cubic feet of free air per minute.

The lifting hooks are suspended from an internal truss located just beneath the center of buoyancy when the pontoon is in a vertical position. The truss is riveted and welded to the pon-

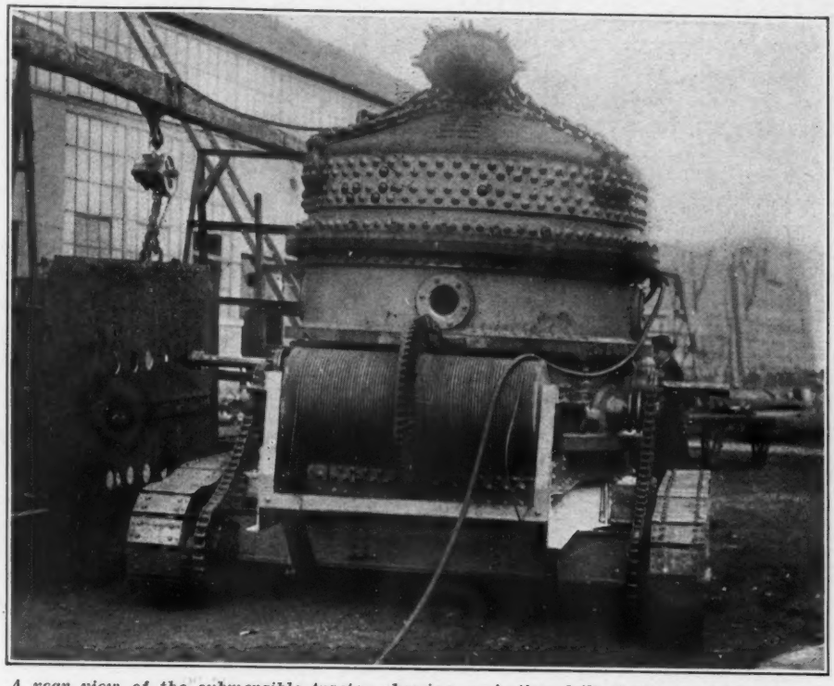


The salvage plant and the United States Coast guard Cutter "Scally" after the vertical pontoons had raised the totally submerged craft from the bottom of Long Island Sound.

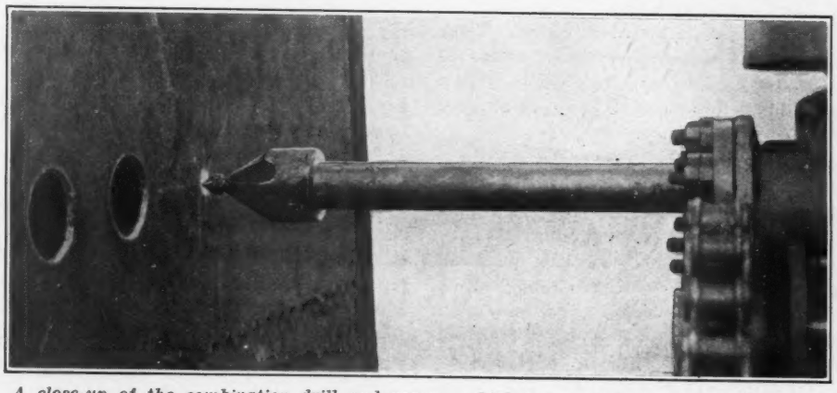
toon, and this arrangement insures a perfect distribution of the load to the cylinder and yet permits the pontoon to be built of comparatively light material. As a matter of fact, this feature of the design is intended to be somewhat elastic, and, in combination with the cushioning action of the buoyant air, to play the part of a shock absorber when the pontoon is affected by wave motion. In this way, Mr. Reno takes care of suddenly developed stresses which might either injure the salvage equipment or damage the hull of a vessel being salved.

The tractor, when submerged, represents a dead weight of about eight tons. This is ample to enable it to forcibly pull a pontoon from the surface down to the point of attachment against a reserve buoyancy of two tons. The electrically operated down-haul drums are at the rear of the tractor conning tower, and are actuated by a motor inside the working chamber. The drilling shafts, also electrically driven, are seen projecting from either side of the working chamber, and the tool employed is a combination drill and reamer which cuts a hole large enough to accommodate the sturdy lifting hooks. The latter are shoved into place by two T-headed thrust rods which extend from the front of the tractor. These thrust rods are controlled mechanically by the men inside the machine. The tractor is fashioned of heavy steel and is capable of withstanding the crushing force of the sea at a depth of 400 feet. This under-water vehicle is equipped with powerful searchlights which, in the relatively clear water found on most coasts, should provide ample illumination, within a range of a few feet, to permit the man at the wheel to guide the tractor to the desired objective and to see a ship's side while boring the holes and shoving the lifting hooks into them. Current is led by cable to the tractor from a dynamo on the surface craft.

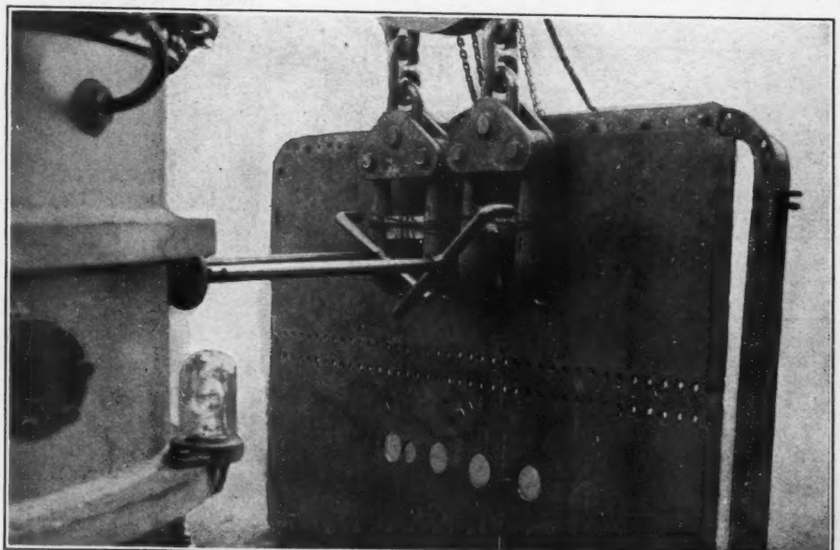
The tractor is provided with an air-regenerative system consisting in the main of a cylinder carrying soda lime, through which the air can be pumped from time to time to remove excess moisture and carbonic acid gas. However, experience has shown that there is enough free air within the working chamber or conning tower of the tractor to supply the physical needs of a crew of two men for more than 24 hours. It would be entirely practicable to install, in combination with the regenerative equipment, a tank charged with pure oxygen. This would considerably amplify the margin of safety and the time during which the operatives could survive inside the tractor if it were unexpectedly detained under water. Within the casing of the power cable is carried a telephone circuit, so that the men inside the working chamber can maintain vocal communication with the people at the surface. The tractive belt on each side of the vehicle can be operated independently and made to move



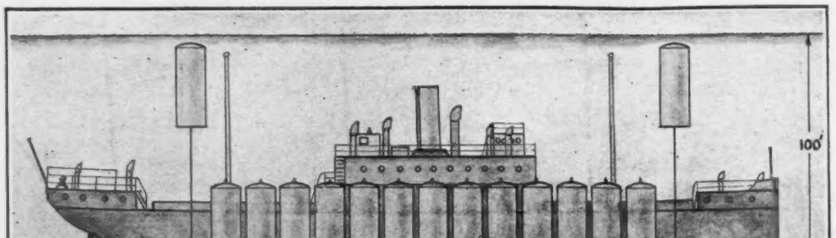
A rear view of the submergible tractor showing projecting drill shafts at right and left and the drums of the power-driven windlass by which the pontoons are forcibly pulled under water to the desired depth.



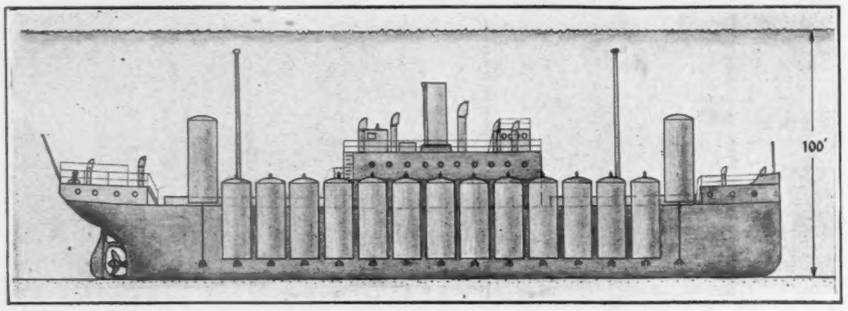
A close-up of the combination drill and reamer which is operated electrically by a motor inside the under-water tractor. It takes but a few minutes to bore a hole through the hull plating of a submerged ship.



This illustrates the manner in which the lifting hooks are forcibly shoved into the holes drilled by the submarine tractor. Two T-headed thrust rods, controlled from within the tractor, do this work.



Pilot pontoons, forward and aft, lying just below the surface and ready to determine the final buoyancy needful to raise the ship from the sea bed.



Pilot pontoons hauled down preparatory to lifting the sunken craft. When filled with air, these pontoons will float with their tops just above water.

in a forward or backward direction. Thus, the machine can be steered easily and turned almost within its own length. The tractor is purposely geared low, and its speed of advance is about 30 feet a minute.

The work of raising the *Scally* proved a valuable experience to the engineers of the Reno Marine Salvage Corporation; and, among other things, that exploit revealed the desirability of means by which the dead weight of a totally submerged ship can be determined with approximate exactness. In answer to this demand, Mr. Reno has devised what he terms "pilot pontoons." That is to say, after he has placed a sufficient number of pontoons on each side of the submerged vessel to exert nearly enough buoyancy to lift her dead weight, he attaches four more pontoons—one at each end of the flanking lines as indicated by some of the accompanying illustrations.

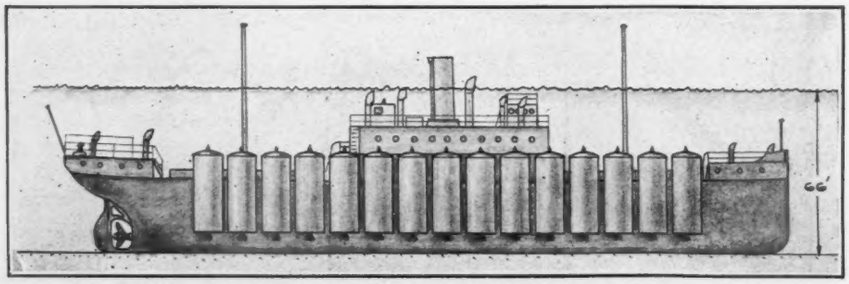
The pilot pontoons are known to have enough potential buoyancy, when suitably charged with air, to bring the sum total of the buoyant effort of all the pontoons to a point which will cause the wreck to rise, but their method of functioning is somewhat different from that of the other pontoons which are held submerged and are snugly arranged around the hull. When the hooks of the four pilot pontoons are attached to the sunken ship, those pontoons are allowed to mount surfaceward upon cables that run through axial passages. The tops of the cylinders then project only a foot or so above the tide. Next, the cable on each pontoon is tautened and gripped securely so that any air forced into these pilot cylinders will tend to make them exert a lift.

With these preparations finished, the salvor turns compressed air into either the bow or the stern pair of pilot pontoons until their buoyancy has reached a stage that enables them to raise that end of the vessel clear of the water bed. The quantity of air required to accomplish this is a gage of approximately half the dead weight of the submerged craft. Thus, the remaining load of the opposite end of the boat can be similarly ascertained; and when all four of the pilot pontoons are properly charged with compressed air the wreck will be lifted from the bottom—the height depending upon the length of the pontoons and the quantity of compressed air forced into them. In salvaging the average large ship, Mr. Reno would employ pontoons having a diameter of 15 feet and a length of 46 feet, and each of these would be capable of exerting a buoyant effort of 200 tons.

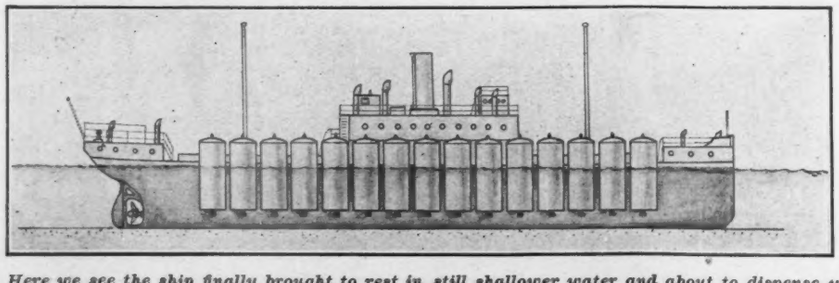
By utilizing pilot pontoons, it will be practicable to control very nicely the entire operation and to keep the damaged craft below the sweep of battering waves while moving it shoreward in vertical steps of from ten to twenty feet at a time—the vessel being allowed to ground successively as she approaches shallower water. By this procedure a wholly immersed boat could be recovered from depths much beyond those in which the average diver could work; and the wreck could be lifted and towed in the manner described and safely deposited in a sheltered harbor where final salvage efforts could be conducted with comparative ease.

Even though the Reno pontoons have their lower ends open when floating vertically in the water, still they can be readily transformed into surface craft by temporarily sealing their open ends. Arranged in this manner, the pontoons float horizontally and can be towed long distances, so it is claimed. This mobility would certainly prove of value when assembling a large number of pontoons at the site of a submerged ship. It might be of interest here to mention that it is entirely practicable to lengthen the pontoons by attaching supplemental units, which have been designed for that purpose. Mr. Reno declares that these additional lengths can be quickly adjusted.

This Magazine has previously emphasized the improvement in the art represented by the development of submergible vertical pontoons. This subject was discussed at some length in the September issue of 1920. Submergible horizontal pontoons are not novel; and it has been definitely established that the length of pon-

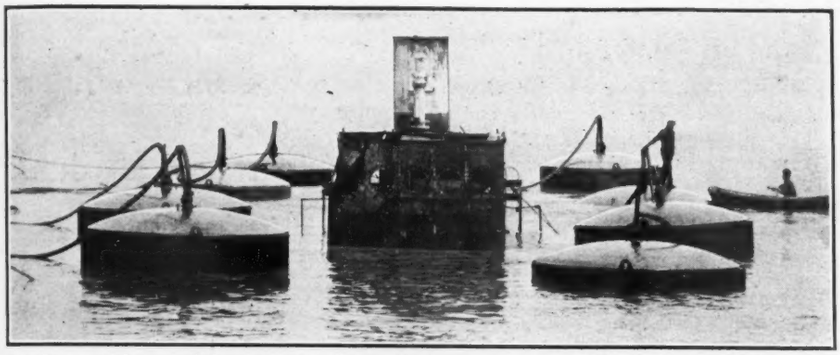


The wreck has been moved by a succession of lifts and grounded in shallow water where the next stage will bring her hull above the surface.



Here we see the ship finally brought to rest in still shallower water and about to dispense with the vertical pontoons which have achieved her recovery.

toons of that sort limits the number of them that can be successfully placed about a sunken craft. The vertical pontoon, on the other hand, is not so restricted—its diameter rather than its length prescribes the number that can be grouped about a vessel and used to advantage. Further, to meet service conditions in the open sea, a vertical pontoon does not have to be built as ruggedly and heavily as a horizontal pontoon and, therefore, measured by the weight of material used, the vertical pontoon is able to exert a greater proportionate lift.



Looking at the wreck bow on with the vertical pontoons in position for the final lift.

It is safe to say that steel ships lying at depths not exceeding 200 feet represent craft that might be brought to the surface by the Reno system unless unfavorable circumstances interposed. Around the British Isles and along the coast of France there are hundreds of wartime victims that might be attacked with a fair promise of rich returns by this new departure in salvage equipment. It is authoritatively declared that estimates made by the British Admiralty place the value of these vessels, exclusive of their cargoes, at many hundreds of millions of dollars. A goodly number of those steamers carried individual cargoes, running well over $1,000,000, consisting of bullion, copper, rubber, brass goods, and other materials which would show little if any deterioration because of their exposure to the sea.

It is believed that this is the longest stretch of lining the San Fernando tunnel, one of the longest in the Southern Pacific Railroad Company's western system, was the way in which the concrete was mixed outside the tunnel and then blown by compressed air through a 6-inch wrought-iron pipe directly into the forms. The tunnel is 6,978 feet in length; and, as the work progressed, the concrete was delivered pneumatically a distance of 4,000 feet.

SHOOTING CONCRETE 4,000 FEET BY AIR

A VERY interesting feature of the work of lining the San Fernando tunnel, one of the longest in the Southern Pacific Railroad Company's western system, was the way in which the concrete was mixed outside the tunnel and then blown by compressed air through a 6-inch wrought-iron pipe directly into the forms. The tunnel is 6,978 feet in length; and, as the work progressed, the concrete was delivered pneumatically a distance of 4,000 feet.

concrete has ever been "shot" in this manner on any American railroad, and probably on any other project. The impulse air was furnished by two compressors operated by two 200-H.P. motors.

The entire job of lining the tunnel called for an expenditure of over $1,000,000. The lining of the tunnel with concrete obviates fire hazard, and will do away with the necessity of slowing down the trains while they are passing through it. In order to place the concrete, the tunnel had to be enlarged, and, to do this, the timbers had to be renewed; set back; and then cemented in. The concrete is reinforced with steel rods.

One stage of the final work of raising the "Scally" from her watery grave. All the pontoons were not at the moment exerting their prescribed lift. Note the flexible hose by which compressed air was delivered to the pontoons.

According to press reports, the Canadian Pacific Railway is planning a direct outlet for the Peace River country in Northern Alberta by extending that waterway. Survey parties are now engaged in preliminary work; and the cost of the undertaking is estimated at $30,000,000.

THINGS SOMETIMES OVERLOOKED

THE following extract is from the letter of an engineer in a foreign field, and is suggestively interesting because it reveals just what can happen when all the parts of a machine are supposedly adjusted or assembled in proper order.

"I recently visited a big construction job where a number of compressors were supplying air for rock drills. One of the compressors was running quite nicely, but it was plain that the unloader was not correctly adjusted. Wishing to see what the difficulty was I ran the pressure up, expecting the safety valve to blow at 100 pounds. But the pressure mounted to 110 pounds without giving any signs of blowing, so I unloaded the machine and proceeded to search for the reason why.

"The safety valve was of the weighted lever type, and was set for 100 pounds; so I eased the weight, but without results. Even when I took off the weight its removal had no effect. Accordingly, I concluded that I was confronted with a stuck valve, and I rattled the valve stem without achieving anything. By pushing the lever right up I eventually got the valve to blow and then, to my mortification, and not until then, did I discover that the valve was on back to front so that the pressure, instead of opening the valve, tended to close it more tightly.

"I may say that this machine had been operating to everybody's entire satisfaction for about three weeks in spite of the condition of the valve; and, as the man in charge might never have thought to test his safety valve, things might have gone on unchanged until the compressor went to smash and, possibly, made an equally sudden end of its attendant."

The moral to the foregoing story is: *Read carefully the book of instructions furnished by the compressor manufacturer.* The following quotation is pertinent: "See that the safety valve is in working order, and test it occasionally by lifting the lever or raising the pressure to the blowing-off point."

ARTIFICIAL WOOD—ANOTHER IMITATION

A SCIENTIST from Norway is said to have succeeded in making artificial wood which has all the characteristics of natural wood. The specific gravity of the new product, so it is reported, is the same as that of wood; and it is as hard as oak. It can be sawed, planed, bored, nailed, painted, stained or polished, in short, it can be worked up in every way, shape, or form like real lumber.

Two outstanding advantages claimed for the material by the inventor are that it is proof against rot, owing to its contained chemicals, and that it ignites at a much higher temperature than that at which lumber ordinarily begins to burn. The artificial wood is composed of a mixture of 50 per cent. sawdust, and certain percentages of chalk, chemicals, etc., which is subjected to heavy pressure.

The tanning of leather by chemical processes is steadily gaining ground in Greece.

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EDITORIALS

COMPRESSED AIR CAN PROTECT DAMS AGAINST ICE

WHETHER or not the Great Lakes-St. Lawrence deep-water route can be developed economically and commercially as its advocates claim, the engineering world does regard the project sympathetically because its execution would bring to a focus much ripe experience and utilize mechanical facilities that have been employed with conspicuous success in other great construction tasks.

Not long ago, a vigorous opponent of the scheme advanced the theory that the waterway could not be used as its proponents urged—in short, declared that the plan was impracticable because dams athwart the St. Lawrence River would be carried away by an annual ice barrage representing the cumulative load of 950,000 tons every hour. This difficulty, so it was asserted, was of a nature and a magnitude which neither art nor ingenuity could overcome. The foregoing conclusion impels us to call attention to an article which appeared this year in our January issue under the title, *Safeguarding a Dam Against Harmful Ice Pressures.*

The story told there was about the dam at Keokuk, Iowa, which transforms the flow of the Mississippi River into a source of tremendous hydro-electric energy. We all have a fair conception of the might of that river; and the dam in question has a total length of 4,649 feet and a height of 53 feet from bedrock to its top above the surface of the stream. At times, the temperature in the winter season drops low enough to produce far-spread fields of ice ranging in thickness from 12 to 24 inches. As a matter of fact, the movement of that ice did menace the structural integrity of the dam and came near to carrying away or gravely damaging a number of the essential spillway gates. Happily, engineering resourcefulness saved the day and developed a simple and, withal, comparatively cheap defense in the form of an ingenious application of compressed air.

Why shouldn't similar installations on dams erected in the St. Lawrence fulfill an equally protective mission during the winter months? Experience at Keokuk over a period of years would seem to answer affirmatively and to justify the belief that ice in the St. Lawrence would not, in itself, constitute an insuperable obstacle to the building and the maintenance of the contemplated dams.

AERIAL NAVIGATION

IN THE FIELD of modern mechanical achievement, if there be anything at the present time of which we are disposed to be more boastful and self-gratulatory than of any other, it is in the matter of our aviation successes—speaking, of course, of the heavier-than-air machines. We set out to beat the birds of the air in their own distinct specialty, and, already, they are left far behind in speed of flight and in altitude of ascent, with wide possibilities of more astonishing achievement in the same direction.

Even so, these gratifying successes are revealing to us our limitations; and we cannot help but think that the birds, small and big, if they could know all that is going on, would laugh at us with little fear of being unable to hold their own. Though we are beating the birds in actual straightaway flight, once we are up, our mounting and alighting must always be more or less perilous and awkward, while the bird is always graceful, always safe, and is capable of perfect precision of movement as it wills at the moment. Here, indeed, we may hope to show great improvement, but in some other particulars our case would seem to be almost hopeless.

Our aviation pilotage is far behind our aviation engineering, with little hope that the one will ever overtake the other. When we are aloft, and in most successful flight, we are compelled to keep going even though we know not where we are or where the place we seek may be. It is inconceivable to think of any bird ever being embarrassed in the same way.

Our aviation experiences thus far do not seem to throw a ray of light upon the mysteries of bird migration. There appears to be no limit to the precision of their transcontinental or intercontinental changes of habitat with the procession of the seasons. The scarlet tanager, weighing perhaps a couple of ounces, has embodied within its minute organism not only the motive power and the mechanical devices for its continuous and extended flight but, what is more wonderful than that, also all the scientific devices—as we would call them—to be employed in laying and in directing its course, so that, without guidebook or passage ticket, it can spend the spring and summer with us and find another summer in Peru while our winter rages.

So the bobolink, with its incomparable melody, and variously known as the reed-bird or the ricebird, finds its living in different localities as the seeds successively mature, and is never late. It spends the winter in Brazil and is back again when our summer returns. Perhaps more remarkable still is the itinerary of the golden plover which nests just under the Arctic Circle and winters in Argentina, 8,000 miles away—making a 2,400-mile flight over the open ocean from Nova Scotia to Venezuela. It returns by a different route, all overland, following the Central American Isthmus, thence through Mexico to Texas, and on up the Mississippi Valley.

The familiar birds which nest in our own trees, or in the little houses we build for them, we know travel thousands of miles and return to us year after year. We carry a pigeon 500 miles from its nest and throw it up into the air, where it will circle around once or twice and then start off in a direct line making a mile a minute for the entire distance.

And so it goes. The greatest thing we have thus far learned in our aviation experiences is how much we are unable to do and how little we have come to even guessing how to do it. Here, as in every other domain of investigation or experiment, the more we know and the more we do the more there is ahead of us still unlearned and still undone to tempt us on with just enough encouragement to keep us going.

COPPER CONSUMPTION ON THE INCREASE

THE GARNERING of copper from the bowels of the earth calls for the labor of men not only in the mines but likewise in explosives plants and in the machine shops where the indispensable pneumatic tools are fabricated which drill deep into the metal-bearing rock. Therefore, a growing demand for copper brings in its train a healthful increase of employment in many departments of activity.

There was a time, and that but a short while back, when copper was virtually a drug upon the market. This state of affairs has changed latterly, and recent figures reveal that there is a steadily augmenting consumption of this serviceable metal in the old as well as in the new fields of usefulness. The American Bureau of Metal Statistics has put copper consumption in the United States in 1922 at 1,091,397,000 pounds, and has contrasted this with the 904,753,000 pounds used by us in 1921—a heartening difference of 186,644,000 pounds.

No inconsiderable part of the gain in the utilization of this metal has been due to the development of the electrical industry, which is mainly responsible for the stimulated demand for copper. But another and an important factor in the upward trend has been a widened adoption of copper in building. Copper shingles are extensively supplanting shingles of wood and of other materials; and thousands of structures are now being outfitted with copper leaders and gutters that heretofore have been

equipped with similar facilities fashioned either of tinplate or galvanized sheet iron. Copper tanks, copper piping, and copper fly screens are rapidly gaining favor among home builders and house owners.

In short, this industry, which was profoundly upset after the World War, has now worked its way back to a stabler and better condition; and let us hope that it will continue to hold its own in the onward march of business.

BESSEMER HISTORY

ONE OF the most notable events in the history of modern industrial development was undoubtedly the invention and practical operation of the Bessemer or pneumatic process of steel production. Yet, it has already come to the end of its brilliant career; and the plant established for its demonstration at Sheffield, England, in 1856 is to be dismantled.

The Bessemer story aptly illustrates the stupendous task with which the revolutionary inventor is almost inevitably confronted. The idea of driving a blast of air through a mass of molten metal for the purpose of burning out the carbon might, perhaps, have been a little more than just an ordinary thought; but no one could more than approximately predict what was to be the precise result. Experiment, in fact repeated experiments, only could determine the practicability of the scheme. And then the details of the means and the methods had all to be planned, and construction had to be provided for. A fortune of more than ordinary size was demanded at the very beginning, perhaps to be sunk beyond recovery.

The process succeeded beyond all expectations. A material was produced incomparably superior to anything preceding it, and at a much lower cost. The local steel makers refused to have anything to do with it until the Bessemer people offered the steel at about half the price hitherto known. Then it was that the steel manufacturers were brought to terms, and they arranged to use the process by a system of royalties.

It is told that "after fourteen years the works were sold for twenty-four times the amount of the whole subscribed capital of the firm, on which, during the partnership, a sum equal to fifty-seven times the gross capital had been already distributed in profits, so that, apart from the huge sums which the inventor received in royalties for the use of the patent, each of five partners had, in fourteen years, made eighty-one times the amount of his subscribed capital."

The initial success of the Bessemer process was by no means as straight and as smooth as this story may suggest. There were difficulties, disappointments, and failures in trying to produce a reliable product. A valuable contribution to the art came from Robert Mushet, who showed that the addition of a certain small quantity of spiegeleisen to the molten Bessemerized mass had the effect of removing the obstacles.

The incident suggests how the pioneer of the new industrial age, the Age of Steel as we all agree to call it, gave a new stimulus and impulse to the investigators, experimenters, and inventors of the time, with the result that Bessemer's great achievement is lost and buried in the mass of new productive methods and devices.

"WHY DON'T THE CHILDREN FOLLOW THE PARENT?"

IN THE discussion on immigration in Congress, someone asked the question, "Why don't the children follow the parent?" This is a very logical query, and points to a serious condition affecting the farmer, the manufacturer, and the worker.

There is at present an acute shortage of common labor in America. The supply is not equal to the demand. This is shown clearly by the index figures used by the Federal Reserve Banks and compiled from reliable sources. In the past two or three months unskilled workers' wages have gone up 10 per cent. The index number for unskilled workers is 218, which means that it is 118 per cent. above the base line of pre-war conditions, or an increase of 34 per cent. over the low point of 1921.

Let us compare this with the cost-of-living figures. The index compiled on the same basis shows that the cost of living, which went up to 205 in 1920, now stands at 160, that is, 60 per cent. above par or pre-war conditions. In other words, the wages of common labor have increased 118 per cent., while the cost of living has increased 60 per cent.

It is a well-known fact that a common laborer spends from 35 to 40 per cent. of his income for food. His average weekly wages will now enable him to buy twice as much wheat as in 1913. This relative comparison applies in almost equal proportion to the prices of hogs, beef, and other farm products. In other words, there is a distortion or, as Mr. George E. Roberts, the economist, expresses it, an unbalanced condition between the buying power of the laborer and the buying power of the farmer. It is plain that such a situation cannot continue without bringing about serious results. Farm production will decline; industry will be restrained; and the output of manufactured goods will be curtailed.

No one can reasonably object to labor getting high wages. The blame for a dangerous and uneconomic condition, due largely—and in the case of common labor almost entirely to a restraint upon the supply of common labor, is not being put upon the worker but, instead, upon the system or policy, upon our legislators. The worker, himself, is like Samson, pulling down upon him the columns of the temple, for, under such circumstances, he can enjoy a period of only temporary prosperity.

Common labor does not necessarily require education or experience: it is simply a matter of health and muscle. No one wants to do common labor; and the reason why clerks, teachers, and others do not take advantage of the high wages paid labor and change their jobs is because of a fundamental and a very creditable ambition to rise above menial work. In Europe, the son of a laborer usually "follows the parent": he has not the opportunity, and rarely the ambition, to go higher. In some countries, this is partly due to limitations in the educational system. Not so in America. Here the door of opportunity is open to everybody.

A wise workman, through thrift, will have his children educated and prepared for a trade. Many of us can remember the time when an Irishman was the common laborer in the United States. He is now a mechanic, a policeman, a bricklayer; and, in latter years, we have had to fall back upon Italian immigrants for our supply of common labor. They have shown capacity to do a good day's work and to save; and yet, through the restrictions imposed by our immigration laws, Italian labor is now scarce to the point where the situation threatens a decline in our prosperity, if not a period of depression.

AUTOMATIC TRAIN CONTROL MAKES GOOD

HUMAN fallibility, as the records show, has long been responsible for a large percentage of the accidents occurring in the operation of our great trunk lines. At some critical stage in the running of a train, the engineer or the fireman, or possibly both, failed to heed or to see a warning signal, and a more or less serious catastrophe followed. Why this should be so is not hard to understand if we grasp for a moment the nature of the engineer's task and the multiplicity of the responsibilities which are his in all sorts of weather, night and day. The speed at which his train moves calls for continual watchfulness; and his mind must work even more rapidly if he is to properly respond to the semaphores or lights displayed along the way.

The object of automatic train control is, therefore, to relieve the man at the throttle of much of the stress to which he is now subjected and yet in no wise to hamper his control of his train. After many years of experimenting, a number of systems have been devised which meet the exacting requirements imposed by the Federal authorities; and, because of this, the Interstate Commerce Commission has ordered 49 of the principal railroads of the country to install automatic-train-control devices on 5,000 miles of their lines by January 1, 1925.

In conformity with this action, the Pennsylvania Railroad has been trying out for substantially a year an automatic system which has given great satisfaction. The equipment has been installed on 50 miles of track between Lewiston Junction and Sunbury, Pa., and by it all traffic, both freight and passenger, has been controlled for a month or more. The primary operative forces are electrical and pneumatic, and these serve to function certain mechanical apparatus which, under given circumstances, supersede the office of the engineer. That is to say, without human intervention, the train is automatically slowed down or even brought to a stop if the arrest of headway be essential to safety.

The layman little realizes the inventive cunning, the engineering skill, and, withal, the expense that has been involved in this department of research and security. It has taken a vast deal of labor and technical resourcefulness to eliminate the "bugs" and finally to produce equipment which could be depended upon to perform positively and pre-

cisely at the proper instant and not go wrong and occasion untoward confusion of traffic. What the Pennsylvania Railroad and others have achieved to this end is splendid evidence of native ingenuity and a heartening promise of added safety in railroad operation. Apart from increased protection to life and limb, the lightening of the load upon the man at the throttle will lessen property losses now amounting to millions of dollars annually.

NEW BULLETIN ON STEAM-DRIVEN COMPRESSORS

THE Ingersoll-Rand Company, 11 Broadway, New York City, has just issued a new 36-page bulletin describing their "Imperial" Type XPV, steam-driven air compressors. This class of compressors is built in various sizes and types.

The manufacturers call attention particularly to the steam valve gear which is used on these machines. The gear consists of completely balanced piston valves with riding cut-off valves which telescope within the main valves. The valve gear will operate under any commercial steam pressure or degree of superheat, and has shown itself to be very satisfactory on either low or high-speed steam-driven compressors. As might be expected, the gear is decidedly economical when used with ordinary saturated steam.

One of the outstanding features of Type XPV compressors is the automatic cut-off governor. This governor, which exercises control through the medium of oil pressure, performs automatically three functions: it maintains a constant air pressure regardless of the air demand; it regulates the steam cut-off so as to take care of varying steam conditions; and it adjusts the speed of the compressor to the demand for air and prevents the machine from exceeding the maximum safe limit.

These functions are brought into play by automatically controlling the cut-off in the high-pressure steam cylinder of compressors equipped with compound steam cylinders. Compressors having simple duplex steam cylinders are provided with automatic cut-off control on each cylinder.

The question of compressor regulation is extremely important owing to the fact that compressors are often bought with an eye to future rather than to present needs, and because of this the average compressor is not called upon to deliver its maximum output in the beginning or all the time. Consequently, as the manufacturer points out, the economy of a compressor when running at full speed and working to capacity does not necessarily represent the machine's ordinary or service efficiency. This factor is shown truly when the compressor is operating at full and at intermediate speeds—in other words under average load conditions. The oil governor serves to maintain this economy under a wide range of loading.

Additional features of design, which are illustrated and described in detail in this bulletin, include, among other things, Ingersoll-Rand plate air valves which are used for both intake and discharge; a unit construction which requires a very simple foundation; and an automatic flood system of lubrication.

ANNUAL REPORT OF THE SMITHSONIAN INSTITUTION for the fiscal year ending June 30, 1921. A volume of 638 pages issued by the Government Printing Office, Washington, D. C.

IN ADDITION to outlining the main activities of the Institution, which are extensive and of the utmost importance, the issue contains a general appendix. The object of the latter is to furnish brief accounts of scientific discovery in particular directions; reports of investigations made by collaborators of the Institution; and memoirs of a general character or on special topics that are of interest or value to the numerous correspondents of the Institution.

It is not possible here to refer to all the papers treated in the pages of the appendix, but one of them, *The Age of the Earth*, by Lord Rayleigh, F.R.S., and others, is especially interesting because of the bases upon which the different scientists rest their arguments in seeking to approximate the antiquity of this globe of ours. The outstanding comfort to be gathered from these sage deductions is that the terrestrial sphere has endured for 100,000,000 years and more, and, having lasted so long, we may reasonably assume that it will continue to be in existence for eons to come. To most of us today there are a great many questions pressing for solution that concern us more directly than this cosmic and geological conundrum—absorbing as it is from a speculative point of view.

Among other topics dealt with in the appendix are: *The Daily Influences of Astronomy; The Diameters of the Stars; The Yielding of the Earth's Crust; The Heredity of Acquired Characters; Breeding Habits of the Opossum; A Botanical Reconnaissance in Southeastern Asia; The Science of Man; Ancestor Worship;* and *A New Era in Palestine Exploration.*

THE ECONOMICS OF MARKETING AND ADVERTISING, by W. D. Moriarty, Ph.D., Professor of Business Administration, University of Washington. A work of 592 pages. Published by Harper & Brothers, New York. Price, $3.50.

THIS BOOK has been written to meet the needs of two groups: College students and business men having to do actively with the varying phases of marketing and advertising. The author has handled his subject lucidly, entertainingly, and convincingly; and marketing and advertising are made to appear in a light different from the one in which these vital economic subjects are commonly viewed by a large number of the business fraternity.

Professor Moriarty says in his preface: "The text is influenced by the fact that the student of marketing and advertising is presumably going to be not only a business man, but a business man keen enough to understand that he must as a business man attend to his duties as a citizen. For both these functions, this text maintains it is more important for student and business man alike to have a thorough grounding in the application of fundamental economic principles to manufacturing, marketing, and advertising than to have a general knowledge of the technic of distribution in widely different fields. It is taken for granted that the business man will supplement this text by intensive study of the technic of his own field, and that the instructor will supplement it as he thinks necessary or advisable with details of marketing technic or advertising practices." In short, the author emphasizes that his main desire is to bring out his contention that it is the economics of marketing and advertising, rather than description of technic, which should receive most stress and which will contribute most to business judgment.

AMERICA AND THE ATLANTIC, by Vice-Admiral G. A. Ballard, R. N., C. B. A book of 351 pages with several maps. Published by E. P. Dutton & Company, New York. Price, $5.00.

IN HIS preface, the author says: "If Americans have not been the greatest participants in the wars of which the scope and area have been on a world-wide scale, they have certainly been among the leading commentators on such wars in the past, and are likely to be among their leading regulators in the future. For an abatement of competition in naval armaments, without which world-wide hostilities cannot be waged, all nations are indebted to the initiative of President Harding, and for a scientific historical treatment of such wars they are indebted to Admiral Mahan."

Continuing, Vice-Admiral Ballard points out: "Americans stand among the principal referees of the prize ring that extends to every terrestrial meridian and parallel of latitude. But the dramatic story of the direct and close association between the records of their own continent and the great struggles fought out on so vast a stage, and of the constant action and reaction between the strategic situation in the Atlantic and the development of American history, has never been treated as a subject of special study."

The present work is therefore offered virtually as a fairly comprehensive sketch of this absorbing topic in the hope that, by arousing interest, the matter gathered may form a foundation upon which someone else may later on build an imposing superstructure of fuller detail.

GROWTH OF A GREAT CITY

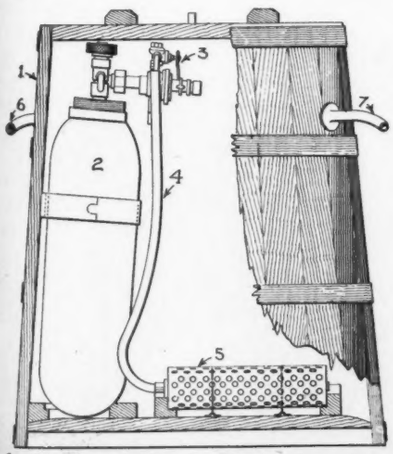
IN commenting on the visit of the Institution of Mechanical Engineers to Glasgow, *The Engineer* calls attention to the fact that the population of that city has multiplied itself by twelve in the last 120 years—from 84,000 in 1801 to 1,000,000, while the population of Great Britain in the same interval has been multiplied only by three. It is, perhaps, ungenerous for us to make mention of it, but the temptation is too strong, that Detroit has multiplied itself by twelve in 50 years; Buffalo, Denver, and Los Angeles, did it in 30 years; while Seattle did twelve times twelve and almost double that in 40 years.

COMPRESSED OXYGEN FOR FISH IN TRANSIT

TO A LIMITED extent in this country it is the commercial practice of some fishmongers to offer their wares to the market "alive and kicking," as the colloquial phrase expresses it. The purchaser then picks out the swimming fish which he may desire; and this procedure makes certain that the aquatic food is fresh. In parts of Europe, however, it is the prevailing custom to sell live fish, and this means that special provision must be made to keep them in a proper condition both during transportation and while awaiting the ultimate consumer.

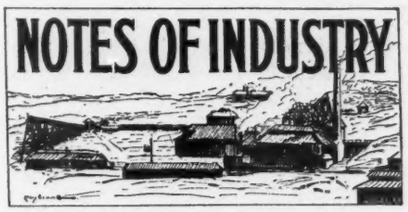
The Germans have developed facilities which promote this traffic by insuring a continual replenishment of oxygen as it is withdrawn from the water by the finny creatures. For this purpose there is installed in the bottom of the shipping container a suitable sieve-like cylinder through which oxygen is discharged into the water in the form of tiny bubbles. As the gas ascends, some of it is immediately taken up by the water, while much of the remainder, on reaching the surface, floats there and is ultimately absorbed by the water owing to the latter's motion in transit.

The sieve or filter is connected by a flexible tube to a reducing valve attached to a metal flask, which is charged with oxygen at high pressure. A special cut-off device in the stop-cock permits the nice regulation of the hourly discharge of the oxygen; and the valve can be set to emit anywhere from 2 to 30-odd liters of the gas every 60 minutes. The quantity of oxygen thus freed is determined by the total weight of the fish and the size of the tank in which they are shipped. The requirements of live fish in such circumstances are generally well known by the people engaged in this sort of fish-handling business.



1—Wooden tank, 2—Flask charged with highly compressed oxygen, 3—Valve regulating the liberation of oxygen, 4—Rubber tube delivering oxygen to the atomizer, 5, 6 and 7—Pipes by which fresh water is delivered to the tank and the overflow allowed to escape.

When once set for a given condition, the apparatus operates automatically, and supplies just the right quantity of air for either a large or a small consignment of fish, as the case may be. By dipping the so-called "transport-automat" in water, in advance of its application, it is feasible to test it and to make sure that it will function correctly during the journey to market. Equipment of this character have been extensively employed latterly abroad, and the results have been highly successful. It is self-evident that kindred facilities may be utilized for distributing by rail, motor truck, etc., fish designed for propagation or for restocking more or less remote bodies of water.



In one of the two large battleships now building for the British navy, Douglas fir from America is replacing teak—presumably because it is much lighter in weight in comparison with its strength.

An invitation is extended to American dairy and allied industries to participate in the International Dairy Exhibition to be held in Milan, Italy, from November 4 to 30. The exhibits are to include dairy products and dairy machinery of all kinds; and every phase of the industry is to be represented. Program and details may be secured from the Italian Embassy, Washington, D. C.

Dr. John S. Unger, Chief of Research Bureau, Carnegie Steel Company, says that 840 pounds of iron is used annually for each individual of the population of the United States, and he gives a suggestive hint as to the routes of its dispersion. American women carry some thousands of tons in the shape of wire that stiffens their hats, while about one-twelfth—we are trying hard to believe it—of the total production goes into tin cans for foods, etc. These cans once used are sent straight to the dump—that is, they make short trips to the scrap heap with no return.

At the plant of Airships, Inc., Hammondsport, N. Y., work has been started on three T. C. airships under contract with the United States Air Service. The T. C. is the latest thing in large training ships to be used by the Air Service. Its principal characteristics are: length, 195 feet; maximum diameter, 44 feet; capacity, 200,600 cubic feet; cruising radius, 1,630 miles at a speed of 47 miles an hour while carrying a crew of six. It is expected that all three dirigibles will be completed within a year.

In the little City of St. Hyacinthe, about sixteen miles from Montreal, is located the world's largest organ-building plant, which turns out a product of supreme excellence. The organs of Cassavant Frères, purely on their reputation, are to be found all over Canada, in a dozen of our states, and now one is to be sent to Paris on the advice of Mier J. Bonnet, the eminent French organist. This is said to be the first organ to leave the American continent for Europe.

At a meeting of the Electric Steel Founders' Research Group, which consists of five separate manufacturing concerns, the various phases of the work being done by the members to improve the quality of steel castings and to increase the efficiency of methods were discussed in detail. Reports were read on such subjects as facing sand mixtures, core sand mixtures, electric-furnace practices, heat treatment of steel castings, production control, porosity in castings, etc. The results obtained so far have been so beneficial that the intention is to take up the study of additional steel-foundry problems, such, for instance, as enter into the making of thin-section electric-steel castings of intricate design.

The British Government, with the assistance of chemical advisers, has been elaborating the regulations governing the purchase of poisons so as to make their procurement more difficult. Dispensers of poisons will now be required to color them in order to minimize the chances of taking them by mistake. Thus, strychnine will henceforth be a brilliant green.

The Spanish province of Valencia is planning to revive silk culture and silk manufacture—industries for which it was famous seven centuries ago.

In a paper read before the South African Institution of Engineers, the writer, Mr. A. E. Simmons, said that an air compressor, installed without due consideration of the operating conditions of inlet and discharge pipes and run without periodical check on its performance, may be a source of considerable and unnecessary expense to its owners. It is not uncommon, he declared, for the total amount of lost work to be equivalent to a 10 per cent. increase in power requirements as compared with the normal best performance—a rather surprising understatement of the case.

In an attempt to assist mining operations in Mexico, the national railroads have lowered the freight rates on shipments of dynamite.

The announcement by the Nitrate Producers Association of Chile that prices for the new year—beginning July 1—would be approximately on the same basis as those that prevailed during the preceding twelvemonth has been followed by large sales. This business has brought about a general feeling of optimism which has, in turn, already made for better conditions in the industry. The number of nitrate plants now in operation has been increased to 62.

About 70 per cent. of the motion pictures used in Denmark are of American origin.

The textile industry of Greece is rapidly gaining ground and promises to become of the utmost importance to that country within the next few years. The great influx of refugees from Asia Minor is believed to be effectually transplanting carpet making into the land of the Hellenes.

STRONG AS STEEL THOUGH LIGHT AS WILLOW

THE TRIANGULAR girders of the mammoth airship ZR-1, which is now nearing completion at the huge hangar of the United States Navy at Lakehurst, N. J., are made of duralumin—an aluminum alloy which is as strong as steel and yet as light as willow. The engineers of the National Bureau of Standards have thoroughly tested out 150 duralumin girders—duplicates of the ones that will be embodied in Uncle Sam's great dirigible. They report that the specimens stood up very well under the most severe service tests. The sample girders were manufactured in the Naval Aircraft Factory at the League Island Navy Yard, Philadelphia, and are finer specimens of workmanship than any previously produced.

The heat treatment to which the duralumin is subjected tends to harden the material so that it is ultimately as strong as the best steel but only one-third as heavy. As originally rolled, the aluminum alloy is very soft, and before being heated it is about one-half as strong as structural steel. After it is heated to a temperature of from 897 to 914° F. and quenched in water or oil, the metal is still very soft and possesses properties diametrically opposed to those of building steel. However, as the duralumin cools, and is allowed to stand, it increases in strength until at the end of one week it is as strong as the best steel ever made; and this despite the fact that duralumin weighs but 150 pounds per cubic foot while a similar amount of structural steel weighs 450 pounds.

Tests to ascertain the tensile strength of duralumin prove the material to be one of the Samsons of the metallurgical world. The metal has a tensile strength of 55,000 pounds per square inch, which is remarkable in view of its lightness. The triangular duralumin girders, shown in the accompanying photograph, weigh less than one-third of a pound per linear foot. This means that a 6-foot girder weighs two pounds—in fact, duralumin is one of the lightest known metals or alloys. Another of its outstanding features is that it resists corrosion even better than pure aluminum. Because of these characteristics, duralumin is admirably adapted to the construction of aircraft.

It is claimed that these triangular girders are produced more efficiently at the Naval Aircraft Station than at any other manufacturing center in the world—in short, that the workmanship is so superior that none of the foreign airplane makers have been able to compete with the United States Navy in this direction. The outer envelope of the ZR-1—which is painted with aluminum to reflect the heat of the sun rather than to allow it to penetrate through to the gas tanks where it might develop untoward pressure and prove dangerous—is firmly secured to the girders, while the available space within the outer covering and between the girders is used for the storage of the gas bags. Every precaution is being exercised in the construction of this record-breaking airship to make her as safe and as sound as possible.

Government reports state that the 16-foot lengths of duralumin girders which make up the framework of the ZR-1 could indefinitely carry loads of 1,000 pounds apiece when used as beams or of 2,600 pounds when used as columns. Utilized as a pillar, a girder of this description did not break down until the load was increased to 5,200 pounds. This test amply demonstrates the strength of duralumin. Despite the fact that a 16-foot girder weighs only 5⅓ pounds, it will, in the shape of a column, support a load equivalent to 945 times its own weight, while the same girder, in the form of a beam, will carry a load of 125 pounds per linear foot when the load is uniformly distributed.

The population of Hawaii is now in the neighborhood of 291,000—an increase of 100,000 since 1910 when the last census was taken.

An example of the metallurgist's cunning. Duralumin makes it possible to construct airship girders which are very strong and yet extremely light.

PRECOOLING CANTALOUPES BEFORE SHIPMENT

THE FIRST lot of cantaloupes to be ripened on the vines and then precooled before shipment to market turned out successfully, according to the United States Department of Agriculture. The cantaloupes were grown in the Imperial Valley of California; precooled in an experimental plant of a local ice company in that vicinity; and then consigned to Chicago for consumption.

The precooling process is as follows: the muskmelons, immediately after they are gathered ripe from the vines, are unloaded at a shed, which is provided with an endless platform carrier. The latter conveys the cantaloupes—four crates to a row—down an incline and into and through a tank of water. The water is cooled to a temperature slightly above the freezing point by means of ammonia coils just outside the intake pipes. With the temperature of the water ranging between 33 and 40° F., the cantaloupes are carried slowly through the tank during a period of 1½ hours. After the fruit, at a uniform temperature of 40° F., is taken from this cooling tank it is forthwith loaded into cars for shipment.

The results of these experiments of precooling melons before sending them to the distant markets have been gratifying. As the investigators declare, the treatment does not impair the quality of the melons. Contrary to expectations, the soaking does not cause the water to penetrate the cantaloupes or to develop mold. The meaty part of the fruit gives no evidence of a soggy condition and the first consignment of precooled melons was in large demand by the consumers. Similar shipments will be made from California to New York City and other eastern markets.

SAVING BY ELIMINATING NEEDLESS VARIETY

AS A RESULT of a conference of producers and consumers of asphalt, called in April of this year by the Division of Simplified Practice of the Department of Commerce, 88 varieties of asphalt used for paving purposes have been reduced to 9, and 14 kinds employed as fillers for brick and stone blocks have been cut down to 4. Inasmuch as 3 of the grades adopted for fillers are identical with 3 of those recommended for paving, there have actually been eliminated 92 brands of asphalt hitherto on the market.

Just what this will mean to the trade was brought out by one manufacturer, who said: "Had this simplification been effected a year ago (early in 1922), it would have saved our company over $200,000." As there are 22 firms within the United States in this business, the saving should be appreciable. The object of the Division of Simplified Practice is to cooperate with various industries in an effort to reduce waste by eliminating superfluous varieties; and from the work already done it would appear that both the manufacturer and the consumer would gain much if other branches of industry were to profit by the service thus rendered by the Government.